INSECTS OF HAWAII

To Harold St. John,
with my compliments,
Elwood C. Zimmerman

INSECTS OF HAWAII

A Manual of the Insects of the Hawaiian Islands, including an Enumeration of the Species and Notes on their Origin, Distribution, Hosts, Parasites, etc.

by **ELWOOD C. ZIMMERMAN**
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VOLUME 3

HETEROPTERA

Sponsored by

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PREFACE TO VOLUME 3

In this third volume of the series *Insects of Hawaii,* 224 species of Hemiptera–Heteroptera, or true bugs, are listed. This group includes some of the finest and most interesting of Hawaiian insects, and they are, in general, better known than most of the other sections of the endemic Exopterygota. There are, however, many new kinds to be described, and little is known regarding the bionomics of most of the endemic species.

The "Preface to the First Five Volumes" (in volume 1) contains a detailed discussion of this series of volumes and should be consulted for general comment and acknowledgments.

The illustrations for this volume were made mostly by Frieda Abernathy, University of California; Arthur Smith, British Museum (Natural History); and W. Twigg-Smith and J. T. Yamamoto, Experiment Station, H.S.P.A.

Dr. Harry Arnold, Jr., editor of the *Hawaii Medical Journal,* kindly gave permission for the use of the material on *Triatoma.*

I owe many thanks to W. E. China, British Museum (Natural History), for reading the manuscript, for answering many questions, for sending many notes regarding types in the British Museum and for much constructive criticism. My close friend, R. L. Usinger, who has contributed so much to the knowledge of the Heteroptera of Hawaii, naturally has taken a keen interest in this volume, and I have leaned heavily on him for aid and guidance. He has read the manuscript, has answered innumerable questions and has helped me in many ways. My colleague, R. H. Van Zwaluwenburg, Experiment Station, H.S.P.A., read the manuscript and proof for the entire volume. I am deeply indebted to these gentlemen for all they have done to make this volume better.

E.C.Z.

Honolulu,
July, 1948

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Order **HEMIPTERA** Linnaeus, 1758

(*hemi,* half; *ptera,* wings)

Proboscidea Scopoli, 1761.
Ryngota Fabricius, 1775.
Rhynchota Fabricius, 1803.

The order Hemiptera is of ancient lineage, for it was highly developed in the Lower Permian, and although no fossils have yet been found in older strata, it must have been well developed in Carboniferous times, judging from its Permian expansion. Essig (1942:265) estimates that the order contains about 150 families and 48,000 species. Some authors have given equivalent ordinal rank to the two suborders Heteroptera and Homoptera, but the obvious, close affinities of the groups and their continuity of morphological features make such a treatment untenable.

Suborder **HETEROPTERA** Latreille, 1810

(*hetero,* different; *ptera,* wings)

The True Bugs

The following diagnosis will distinguish the Heteroptera from the Homoptera:

Fore wings held horizontally and overlapping over the abdomen, usually conspicuously coriaceous at base and membranous distally; rostrum (excepting in the Corixidae) arising anteriorly on head and head with a distinct hypostomal ("neck") region; wingless forms uncommon, but if wingless, with rostrum distinctly arising from the head, not apparently from between the fore coxae.

The suborder Heteroptera is characterized as follows:

Small to large insects of diverse form and structure; usually heavily sclerotized and well pigmented. Head variable, prognathous or hypognathous, usually prognathous, well exposed, usually free; cephalic sutures obscure or obsolete except for the usually distinct epicranial and clypeal sutures; compound eyes large and conspicuous in all our species; a pair of ocelli usually present, but absent in some forms; antennae filiform, long and slender in most forms, four- or five-segmented, free and exposed in all our forms excepting the aquatic series Gymnocerata; mouth parts highly modified and specialized for piercing and for sucking plant or animal fluids (except in the Corixidae, in which group they are modified to enable the bugs to ingest solids such as the contents of algal strands,

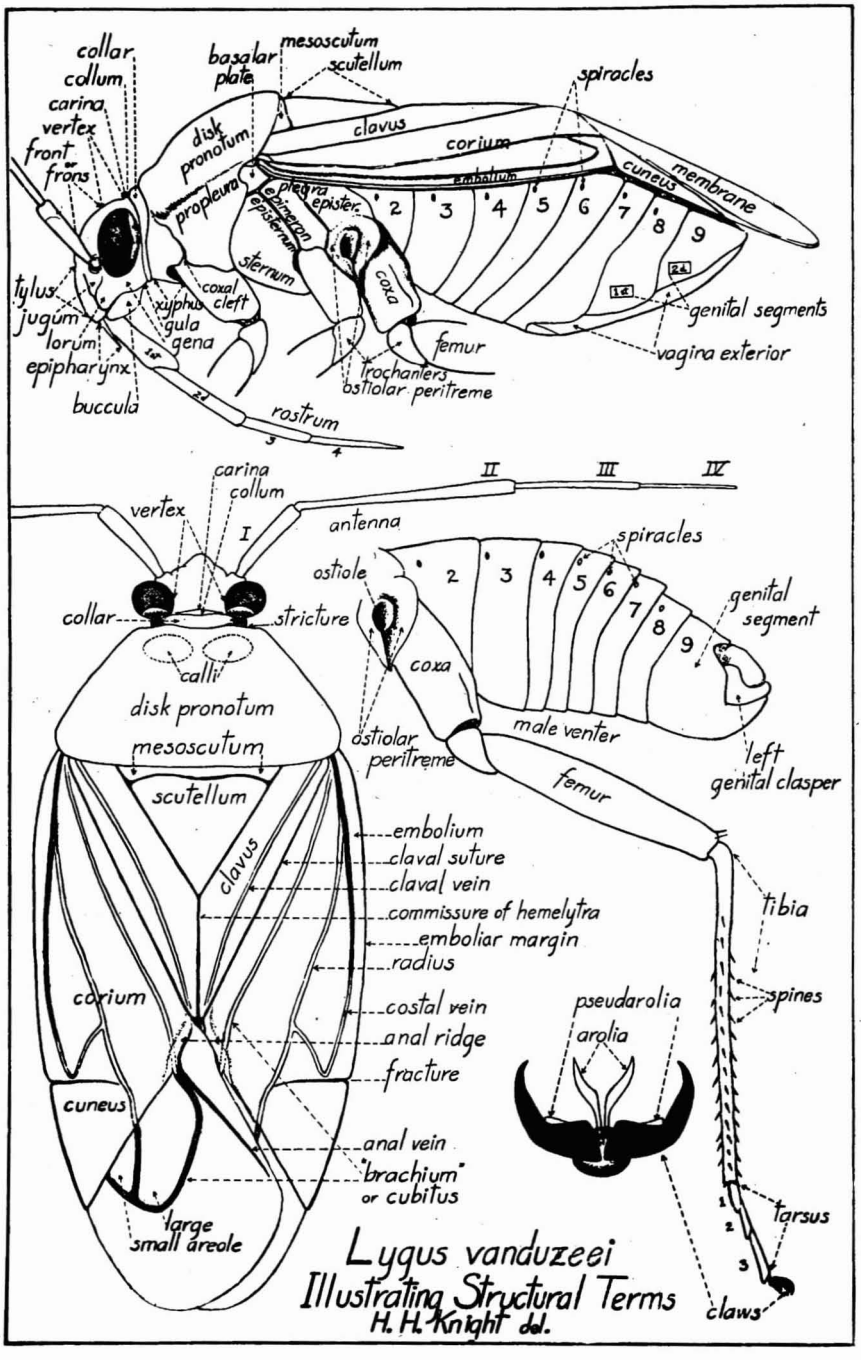

Figure 1—Diagram showing details of a mirid bug. (After Knight, 1917.)

diatoms, etc.), produced into a long, slender, compact rostrum; clypeus, labrum and epipharynx variable, often fused or obscure; labium four-segmented, although it may appear to be only three-segmented because of a shortened first segment, forming the body of the beak or rostrum, grooved to receive the modified, stylet-like mandibles and maxillae which are capable of an in-and-out slipping motion, controlled by muscular action, for piercing the host's tissues; mandibles forming the outer pair of stylets, usually subapically serrated; maxillae forming the inner pair of stylets, sub-W-shaped in cross section, each fitting tightly to the other to form a double-channeled tube, the dorsal duct thus formed is the canal through which the food material is sucked, and the salivary fluids are discharged through the ventral channel; palpi rudimentary or absent; rostrum bent backward under the head or under the head and body (depending upon its length) when at repose, but extending sub-vertically, or sub-horizontally in front of the body when feeding; only the mandibular and maxillary stylets are inserted in the host, the mandibles act as knives and slightly precede the insertion of the suctorial maxillae, the labium acts as a guide but does not penetrate tissues. Thorax with the pronotum usually large and distinct, mesonotum usually highly developed, its scutellum generally large and conspicuous, unusually large in the Scutelleridae and Pentatomidae; metanotum usually reduced. Legs ambulatory, saltatory, or modified for swimming, or raptorial; tarsi one-, two-, or three-segmented, heteromerous in some forms; claws usually apical, preapical in certain aquatic forms only, arolia and empodia present or absent. Wings folded flat and horizontally over back at repose, fully developed, abbreviated or wanting; hind wings membranous, folded beneath the fore pair; anterior wings (called hemelytra) usually thickened and coriaceous basad, and with a smaller membranous apical part, but variable, the basal area usually divided into a narrow inner clavus, and a broad outer corium, the latter may be divided into an outer narrow embolium and a smaller latero-distal cuneus (see illustrations); membrane with or without veins, if veins are present, then with or without closed cells; membrane reduced or absent or coriaceous in some forms, when folded the membrane of one wing overlaps that of the other; venation of both pairs of wings highly modified, especially in the fore pair, veins often obscure. Abdomen basically eleven-segmented, but usually at most only nine or ten segments are distinguishable and only six of these distinct, usually much modified; cerci absent; ovipositor present or reduced or rudimentary, when developed consisting of three pairs of valves and issuing at the base of the true ninth sternite; male with well-developed phallic organs, often with highly modified accessory parts. Metamorphosis gradual. Eggs variformed, diverse in shape, sculpture and kind, laid free, cemented to a substratum, or inserted in plant tissues. Reproduction bisexual. Normally with five nymphal instars, with wing rudiments minute in third instar, distinct in fourth. Principally free-living herbivores, some predators, some bloodsuckers, others obligatory ectoparasites.

The oldest known fossil Heteroptera have been found in Australian Triassic

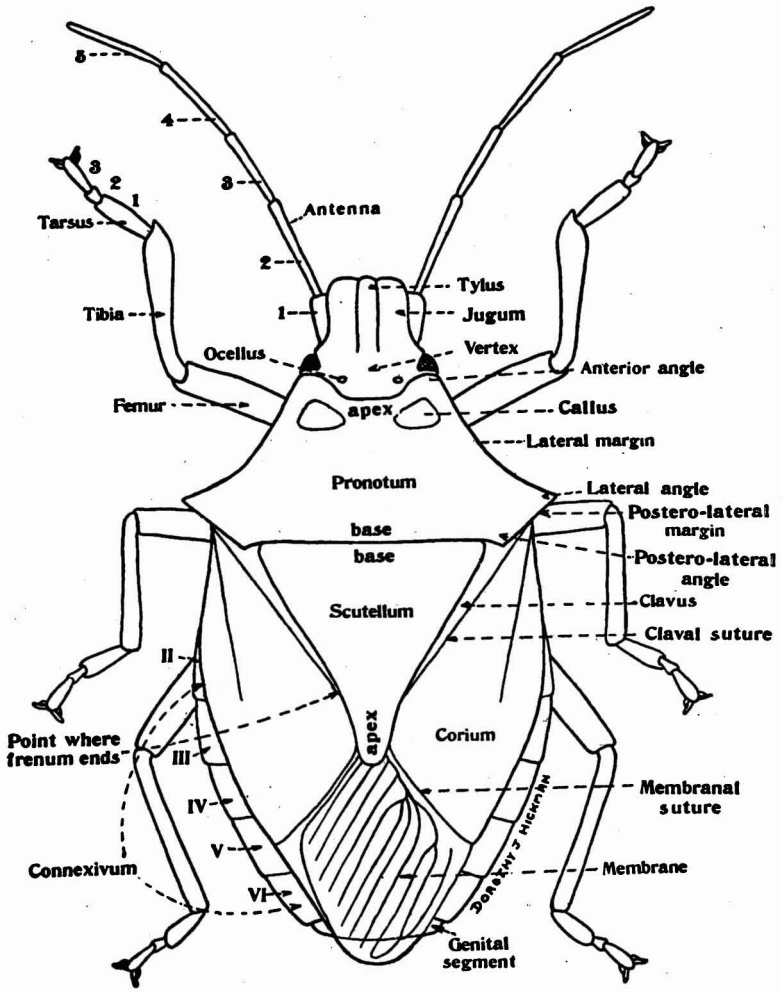

Figure 2—Diagram of features of a pentatomid bug. (After Parshley, 1923.)

formations. Cretaceous and Tertiary fossil Heteroptera are common, widespread and multiform.

Geographically the Heteroptera are perhaps the most widespread of all of the insect orders. They inhabit deserts and subpolar areas, and some are even independent of land, for they are pelagic and live far out on the open oceans.

Heteroptera are found over all our islands from seashore to mountain peaks, and we have representatives of the pelagic *Halobates*. Unlike most orders, native bugs can be found from our beaches to the mountain tops, for some species have been able to adapt themselves to the drastic changes wrought in the lowland flora and fauna since the advent of man.

Here included are 68 genera containing 223 forms known to occur in Hawaii. There are, however, several genera and many species in the collections examined

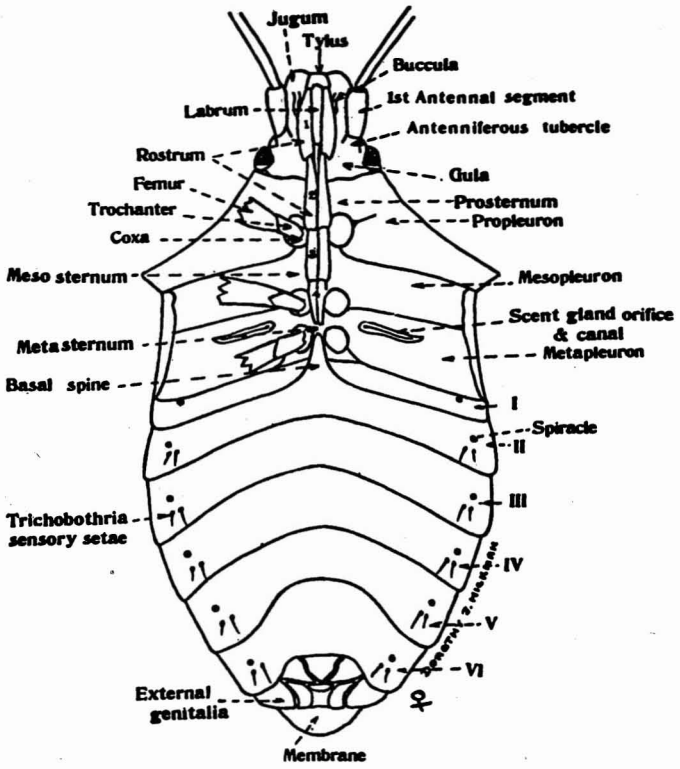

Figure 3—Details of the ventral surface of a pentatomid bug. (After Parshley, 1923.)

which are new or have not been recorded from the Hawaiian Islands. Some groups have proliferated greatly in the archipelago, and the lygaeid *Nysius* complex has a greater development in the Hawaiian Islands than anywhere else. The greatest endemic complexes are in the families Miridae, Lygaeidae and Nabidae.

The first Hawaiian heteropteron to be described was *Oechalia grisea,* which Burmeister described in 1834. W. S. Dallas (1851), C. Stål (1854, 1859, 1870, 1874), F. Buchanan White (1877, 1878, 1881) and Thomas Blackburn (1888) contributed descriptions of new species of Hawaiian bugs before 1900. In 1902, Kirkaldy's paper was published in *Fauna Hawaiiensis,* and this was followed by the supplement in 1910. In 1911 Perkins described some new forms. For more than 30 years the Hawaiian Heteroptera have received little attention except from two workers. E. P. Van Duzee described some new genera and species in 1936, and since that time R. L. Usinger has entered the field and has contributed several noteworthy papers. Usinger has on loan for study a large part of the Heteroptera from local collections, and he intends to revise the entire Hawaiian bug fauna.

Essig (1942:269) recognizes 43 families in the suborder Heteroptera. Of these, only the following 12 families are represented in the native fauna: Scutelleridae (considered a subfamily here), Pentatomidae, Coreidae, Lygaeidae, Enicocephali-

dae, Reduviidae, Ploiariidae (hereinafter fused with the Reduviidae), Nabidae, Anthocoridae, Miridae, Saldidae, and Gerridae. None of the following families gained natural access to Hawaii, although the italicized families are now represented in the islands by immigrant forms which have been imported by the intentional or accidental aid of man: Plataspididae, Podopidae (not considered a family by W. E. China), Cydnidae, *Corizidae* (not considered a family by China), Alydidae (not considered a family by China), Aradidae, Dysodiidae, Termitaphididae, Neididae, Pyrrhocoridae, Piesmidae, Thaumastocoridae, Phymatidae, Polyctenidae, *Cimicidae,* Microphysidae, *Cryptostemmatidae, Hebridae, Mesoveliidae,* Hydrometridae, *Veliidae,* Gelastocoridae, Ochteridae, Naucoridae, Nepidae, Belastomatidae, *Notonectidae,* Pleidae, Helotrephidae and *Corixidae.*

Six of the 12 families represented by endemic species—the Coreidae, Enicocephalidae, Reduviidae, Nabidae, Saldidae and Gerridae — are each represented by a single genus in Hawaii. The Coreidae, Enicocephalidae, Reduviidae and Gerridae each have only one or two endemic species; but *Saldula* of the Saldidae has several species; *Oechalia,* representing the Pentatomidae, has 14 known species; and *Nabis* has a large and diversified assemblage of forms. The Anthocoridae contain six native species in two genera, one of which is a monotypic endemic. Thus, the only families which have a generically complex endemic representation in Hawaii are the Lygaeidae and Miridae. Of these, the Miridae, although now comparatively poorly and inadequately known, is the largest and most diversified group. It is followed by the specifically greatly diversified Orsillini of the Lygaeidae.

According to what I can gather from observations made before 1900, many species of Hawaiian bugs were much more abundant in individuals, and many of them were of much wider local distribution than they are now. The changes wrought by man in these islands have been great, and almost all the native plants and animals have suffered greatly as a consequence. There is no way of guessing how many kinds of lowland bugs have become extinct recently and how many were never collected or described, although living when man arrived in Hawaii. There

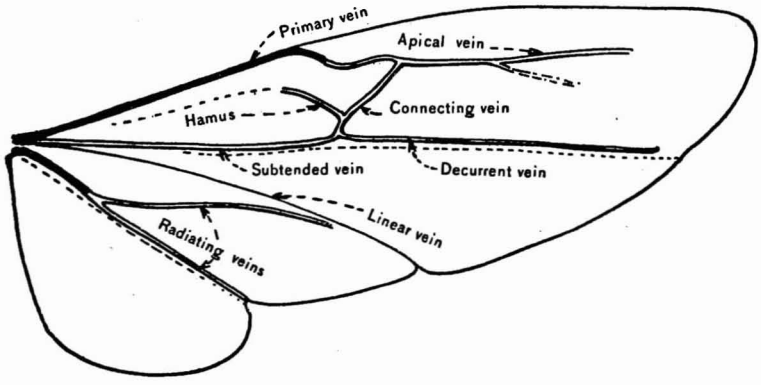

Figure 4—Diagram of the hind wing of a *Nabis* bug to show characters. (After Parshley, 1923.)

are certain exceptions, such as some species of *Nysius,* which have been able to withstand the changing environment and have even taken to introduced plants in the cultivated lowlands in the midst of the areas where introduced predators voraciously forage.

The metamorphosis of the Heteroptera is gradual (paurometabolous); the young much resemble the adult stage, excepting principally alary and sexual development. The wings develop from external bud-like pads and are quite evident in the ultimate nymphal instar. There are normally five well-marked nymphal instars between egg and adult, but some workers have reported finding up to eight instars in certain exceptional species. Only a few of our Hawaiian bugs have had their early stages described, and this great field lies open for much-needed and fascinating research.

Records of parental care in the Heteroptera are rare, but there are some authentic published observations. Frost and Haber (1944) have reported that the females of the pentatomid *Meadorus lateralis* (Say) (a United States species) brood over their eggs and first and second instar nymphs. Kirkaldy (1904:577) reviewed the subject for the order.

Many bugs are well known because of their odoriferous or repugnatorial glandular secretions. Some have an obnoxious odor, but, to some people, the odor of certain species is not unpleasant, and it may resemble certain fruits or chemical compounds. Most groups of bugs have well-developed odoriferous glands which open through a pair of metapleural orifices in the adult. A specialized, roughened, evaporating surface often surrounds each orifice, and the secretion is poured out of the orifices and is retained on the modified metapleural areas until it has evaporated. The metapleural orifices are absent on the nymphs, and in their place are some intersegmental orifices on the dorsum of the abdomen. The nymphs of bedbugs (*Cimex*) have the orifices of the "stink glands" on the first three abdominal tergites, and other families have varied arrangements of dorsal abdominal scent glands. The Enicocephalidae have a single median opening on the fourth abdominal segment, the Nabinae have three orifices on the fourth, fifth and sixth segments, but they are wanting in the Ploiariinae and Triatominae. In all groups the dorsal abdominal glands are only developed in the nymphs and become obsolete at adulthood.

There is considerable variation in the development of the wings in the Heteroptera. Brachyptery and pterygo-polymorphism occur both in the endemic and adventive sections of the bug fauna. In the native groups, brachyptery occurs in species of the following families: Lygaeidae, Reduviidae, Nabidae, Anthocoridae, Miridae and Saldidae. The native Gerridae (*Halobates*) are apterous. The only families containing endemic species which do not have brachypterous endemic species are the Pentatomidae and Coreidae. These two families have brachypterous species elsewhere, however. They are represented in our fauna by only three genera containing endemic species.

The Hawaiian Archipelago, in spite of its high rainfall, mountain bogs, swamps

and rushing streams, is without a native aquatic bug fauna. The aquatic series Cryptocerata is represented by not a single native species of any of its several families. The marine *Halobates* are the only representatives of the Gerridae. The semi-aquatic families Hebridae, Mesoveliidae and Veliidae are likewise missing from the native fauna. Single immigrant species of each of the following aquatic and semi-aquatic families, however, have become established in the islands: Hebridae, Mesoveliidae, Veliidae, Notonectidae and Corixidae. (Although the saldids frequent moist places, I have not considered them to represent one of the semi-aquatic families here. The group is well established in the islands.)

The diversity in form and habits of the members of this order is so great that a general description of the group is difficult. The reader is referred, therefore, to the main body of the text for details which will not be outlined here.

The number of noxious species of the order, considered from a world-wide aspect, is large, but we are indeed fortunate in having few harmful forms in Hawaii. New pest species will break through quarantine barriers and become established here as time passes. A few of our species, however, do cause damage of such a serious nature that biological and chemical control is essential. Chemical control utilizes various contact dusts and sprays, some of which are discussed below under the detrimental species.

The bugs may attack man or animals directly, in which case they suck blood, as do the bedbugs and cone-noses. The damage done to plants and food crops is of two major types. The bugs suck the plant juices and thereby reduce the vitality of the plant, or, if the attack is serious enough, it may kill the plants. The injection of salivary fluids may cause harmful toxic effects and result in physiological upsets. Moreover, some species are carriers of plant diseases and diseases of man and animals.

There are a number of insect predators and parasites of the Heteroptera, but only a few are known in Hawaii. The parasites consist mostly of microhymenopterous egg parasites; the predators are most active in their attacks on the nymphal stages of the bugs, although some attack the eggs.

The damage done by certain bug species is partially, at least, balanced by the good contributed by the beneficial kinds. In Hawaii, truly noxious bugs are represented by only a few species included in the families Pentatomidae, Lygaeidae, Reduviidae, Cimicidae and Miridae. However, excepting for a single species, all of our Pentatomidae are predaceous and may be classed as "beneficial," as also may be the entirely or mostly predaceous families Anthocoridae, Nabidae, Hebridae, Mesoveliidae, Veliidae, Saldidae, Notonectidae and Corixidae. But the beneficial contributions of most of these groups are difficult to evaluate and may really have no bearing on man's personal interests. On the other hand, certain species are known to exercise a definite control on noxious insects and are of indisputed value to man. Among these are the *Cyrtorhinus* mirids which have contributed so much to the control of serious leafhopper pests. Some of the anthocorids aid greatly in the control of some small insects. Some of the water bugs may aid in the control of mosquitoes; the tingid *Teleonemia* was purposely imported to aid in the

control of the *Lantana* weed pest; the Nabidae and all except one of the Reduviidae exert an influence which may at times directly aid man; the *Oechalia* pentatomids are known to contribute beneficially because of their attacks on lepidopterous larvae; and some of the other species enter into the roles of beneficial insects, although their actions are generally inconspicuous and unspectacular. In short, there are more beneficial bugs in Hawaii than there are noxious ones.

A large part of the Heteroptera assembled in local collections is on loan to Dr. R. L. Usinger for revisional study. The absence of this material from Honolulu has somewhat handicapped this work, especially because the conditions brought about by the war have made it impossible for either Dr. Usinger or me to examine the collections.

It may not be out of place to call attention here to the proper pronunciation of the name of the great Swedish hemipterist, Carl Stål, whose name appears frequently on the following pages. We hear it pronounced usually as in *hall* or *call,* as *stall;* it should be pronounced as in *hole* or *coal,* as *stole.*

TABULAR ANALYSIS OF THE HAWAIIAN HETEROPTERA

FAMILY	GENERA	ENDEMIC GENERA	NON-ENDEMIC GENERA	SPECIES	ENDEMIC SPECIES	ADVENTIVE SPECIES
Cydnidae	1	0	1	1	0	1
Pentatomidae	3	0	3	16	15	1
Coreidae	2	1	1	3	2	1
Lygaeidae	17	10	7	103	95	8
Tingidae	1	0	1	1	0	1
Enicocephalidae	1	0	1	1	1	0
Reduviidae	6	1	5	9	1	8
Nabidae	1	0	1	26	25	1
Cimicidae	1	0	1	1	0	1
Anthocoridae	8	1	7	12	6	6
Cryptostemmatidae	1	0	1	1	0	1
Miridae	19	9	10	38	29	9
Saldidae	1	0	1	4	4	0
Hebridae	1	0	1	1	0	1
Mesoveliidae	1	0	1	1	0	1
Veliidae	1	0	1	1	0	1
Gerridae	1	0	1	2	2	0
Notonectidae	1	0	1	1	0	1
Corixidae	1	0	1	1	0	1
Totals	68	22	46	223	180	43

Percentage of endemism in native group: genera, 67.2 percent; species, 99.4 percent (0.6 percent indigenous; one of the two gerrids is indigenous).
Percentage of present-day fauna native: 80.7 percent.
Percentage of present-day fauna adventive: 19.3 percent.
Average number of species per genus in native group: 5.4.
Average number of species per genus in adventive group: 1.1.

The average number of species per genus in the native group (5.4) is really greater, because a large number of endemic species are known to us but are undescribed.

KEY TO THE FAMILIES OF HETEROPTERA FOUND IN HAWAII

1. Antennae concealed from above, shorter than head; all aquatic forms; series **Cryptocerata** 2
Antennae exposed and conspicuous from above, as long as or longer than head; terrestrial and semi-aquatic forms; series **Gymnocerata** 3

2(1). Fore tarsi one-segmented, without claws; head overlapping pronotum above; body not strongly convex above; scutellum hidden; eyes widely separated (water boatmen) ..... **Corixidae.**
Fore tarsi two-segmented, each fore tarsus with two claws; prothorax overlapping head above; body strongly convex dorsally; scutellum visible; eyes large, occupying most of front of head, narrowly separated along median line (back swimmers) ..... **Notonectidae.**

3(1). Claws of at least fore tarsi preapical; aquatic forms with ventrites densely clothed with silvery pubescence 4
Claws of all tarsi terminal; ventrites devoid of dense silvery pubescence and not aquatic forms excepting Mesoveliidae and Hebridae, which have silvery pubescence and which are semi-aquatic 5

4(3). Hind femora extending almost their entire lengths beyond apex of abdomen; thoracic scent gland opening at middle of metasternum; our species marine (water striders) .. .. **Gerridae.**
Hind femora extending only a short distance beyond apex of abdomen; thoracic scent gland openings lateral; fresh-water species (broad-shouldered or smaller water striders) ..... **Veliidae.**

5(3). Ventrites clothed with dense silvery pubescence; semi-aquatic species less than 4 mm. in length with both clavus and membrane membranous and without veins 6
Ventrites without dense silvery pubescence; terrestrial forms 7

6(5). First two antennal segments together not as long as head; tarsi two-segmented, first segment minute and obscure; hind tibiae shorter than length of head and pronotum combined (velvet water bugs) ..... **Hebridae.**
First antennal segment much longer than head; tarsi three-segmented, first segment minute; legs elongate, hind tibiae longer than head and pronotum combined (water treaders) ..... **Mesoveliidae.**

7(5). Scutellum greatly enlarged, extending at least onto membranous part of hemelytra and nearly or to apex of abdomen 8
Scutellum much smaller, never reaching onto membrane of hemelytra (do not confuse pronotum of Tingidae with scutellum, which is hidden by pronotum) 10

8(7). Scutellum reaching apex of abdomen, concealing membranous parts of hemelytra (shield bugs) .... **Scutellerinae** of the **Pentatomidae.**

Scutellum not reaching apex of hemelytra, but slightly encroaching upon membranous parts of hemelytra which are exposed 9

9(8). Tibiae hairy but not spinose (stink bugs) ..... **Pentatomidae.**

Tibiae closely set with long, coarse, strong spines; small black species (burrower bugs) ..... **Cydnidae.**

10(7). Head subcylindrical; front legs raptorial; base of rostrum usually thickened and curved and not held in contact with underside of head when at rest; head without a ventral groove for reception of rostrum; or unusually large species about three-fourths of an inch long (*Triatoma*) 11

Head not cylindrical; fore legs not raptorial; first segment of rostrum straight or nearly so and usually, but not always (see Saldidae), received in a groove on underside of head or held in contact with underside of head when at rest; or with eyes very large and a pair of ocelli situated near median line of head (Saldidae); species never as large as *Triatoma* 14

11(10). Pronotum with two transverse constrictions and appearing tripartite; head constricted behind eyes and also near base, swollen between constrictions, ocelli situated on the swollen lobe (gnat bugs, unique-headed bugs) .... **Enicocephalidae.**

Pronotum not divided into three lobes (only two lobes or none); head not so formed 12

12(11). Small to minute species; hemelytra with a distinct fracture and cuneus and a distinct embolium . . . part of **Anthocoridae.**

Medium- to large-sized species; hemelytra without a fracture and without an embolium or cuneus 13

13(12). Prosternum with a specialized, longitudinal, median, transversely minutely striated stridulatory groove between and before the coxae in which rests apex of rostrum; rostrum three-segmented (reduviids) ..... **Reduviidae.**

Prosternum without such a specialized groove; rostrum four-segmented (nabids) ..... **Nabidae.**

14(10). Ocelli absent 15

Ocelli present (check carefully; they are nearly merged with eyes in Cryptostemmatidae) 19

15(14). Ovoid, flattened, flightless ectoparasites; hemelytra reduced to small pads without a trace of membrane (bedbugs) ..... **Cimicidae.**

Not such insects 16

16(15). Hemelytra with conspicuous net-like or lace-like sculpturing; cuneus absent, and membrane without looped

veins; pronotum with elevated, reticulated keels and produced backward and partially or entirely concealing scutellum (lace bugs) ..... **Tingidae.**

Without such net-like sculpturing; scutellum exposed; pronotum not extended posteriorly 17

17(16). Hemelytra with a distinct fracture on outer posterior side of corium, thus forming a distinct cuneus (see fig. 1) (plant bugs) ..... **Miridae.**

Hemelytra with outer margin entire, without a fracture or cuneus 18

18(17). Fore femora swollen, spinulose beneath; wing membrane with four unlooped veins ..... *Tempyra,* part of **Lygaeidae.**

Fore femora not swollen, unarmed; wing membrane with a looped vein or two ..... *Sulamita,* part of **Miridae.**

19(14). Ocelli located close together near median line of head and about opposite middle of eyes (shore bugs) ..... **Saldidae.**

Ocelli located on or behind a line drawn between posterior margins of eyes, or, if not in such a position, then widely separated and not as above 20

20(19). Rostrum three-segmented; head without bucculae; abdomen without trichobothria (hair-bearing spots on venter) 21

Rostrum four-segmented; head with well-developed bucculae; abdomen without trichobothria 22

21(20). Metasternal scent gland orifices present; cuneus present (flower bugs) ..... **Anthocoridae.**

Metasternal scent gland orifices absent; cuneus absent (our species small, soft-bodied bugs, less than 2 mm. long; ocelli nearly merged with eyes; fore wings semimembranous throughout, divergent behind and partially setose) (jumping ground bugs) ..... **Cryptostemmatidae.**

22(20). Membrane with numerous, usually more or less anastomosing, veins (squash bugs) ..... **Coreidae.**

Membrane with five or fewer veins usually arising from base 23

23(22). Rostrum four-segmented, reaching behind fore coxae in most forms, if not attaining fore coxae then never with a stridulatory groove on prosternum; fore tibiae without a specialized apical pad-like structure on inner side (none of our species more than 10 mm. long) (chinch bugs) ..... **Lygaeidae.**

Rostrum three-segmented, not reaching fore coxae; prosternum with a conspicuous, longitudinal, transversely striated, stridulatory groove; fore tibiae with a specialized flap- or pad-like structure on inner side of apex (length 15–20 mm. in our species) ..... *Triatoma,* part of **Reduviidae.**

Series I—GYMNOCERATA Fieber, 1861

This is the largest group of the Heteroptera, and it contains all the Hawaiian species excepting the aquatic water boatmen (Corixidae) and the back swimmers (Notonectidae). All the species have the antennae exposed and longer than the head.

Family **CYDNIDAE** (Billberg, 1820) Fieber, 1861

Thyreocoridae, in Fauna Hawaiiensis, in part.

Subfamily CYDNINAE (Dallas)

Burrower Bugs, Ground Bugs, Negro Bugs

Small or medium-sized, black, beetle-like bugs of burrowing or soil or ground-litter-frequenting habit. Antennae five-segmented. Rostrum four-segmented. Two ocelli present. Scutellum long and triangular, reaching the wing membrane. Corium large, heavily sclerotized; membrane reaching apex of abdomen, its veins simple. Tibiae coarsely spinose; tarsi three-segmented.

This family is allied to the Pentatomidae, from which group it can be distinguished easily because of its spiny legs.

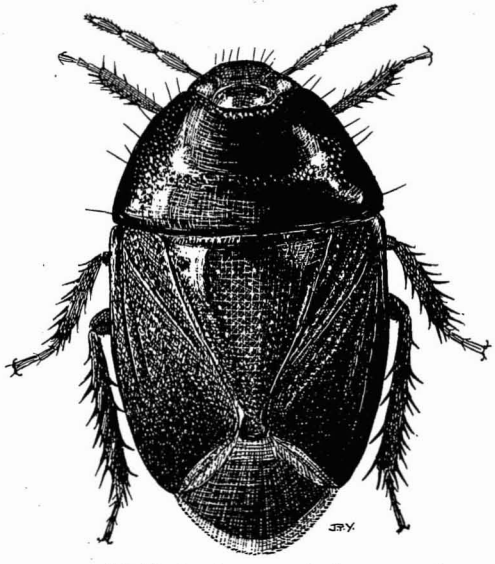

Figure 5—*Geotomus pygmaeus* (Dallas), the oceanic burrower bug. (After Williams, 1931.)

Genus **GEOTOMUS** Mulsant and Rey, 1866

Genotype: *Cydnus punctatus* Costa, fixed by Distant.

This is a widespread genus, one species of which has accidentally been imported to Hawaii.

Geotomus pygmaeus (Dallas) (fig. 5).

Aethus pygmaeus Dallas, 1851:120.

Geotomus subtristis White, 1877:110.

Geotomus jucundus White, 1877:111 (Kirkaldy, 1904:179, says that the type has been lost).

Blackburn (1888:344) synonymized White's two names; see China (1930:89) for additional synonymy.

The oceanic burrower bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Immigrant. A widespread species which was originally described from India and which has been transported by commerce to most of the islands of Oceania. It has long been in Hawaii and was collected by Blackburn.

This shiny black, spiny-legged species is a common and widespread insect in the islands and may be found in numbers, often in colonies, about the bases of plants and in humus and loose earth. I have found the insects feeding in abundance at the roots of the grass *Paspalum fimbriatum,* and they are commonly taken under such objects as boards, stones and cow chips lying on the ground. When disturbed, they release a strong, odoriferous substance. The "pale variety" applies either to the nymphs or to teneral specimens which are brown. They frequently come to light, especially on warm, still, damp nights. The imported toad, *Bufo marinus,* eats quantities of them.

It would be of interest if some student were to work out the complete bionomics of this species.

Family **PENTATOMIDAE** (Leach, 1815) Samouelle, 1819

Shield Bugs, Stink Bugs

Our most bulky native bugs belong to this family, which contains many large, showy species the world over. The families Scutelleridae and Pentatomidae of some authors are treated herein as subfamilies, following the expert and valued opinion of W. E. China. The usual distinction between the families, based upon the length of the scutellum, works well in some localities, but it does not hold for

the Pentatomidae of the world. Some Pentatominae have a large scutellum which extends to the apex of the abdomen and might be placed in the Scutellerinae if this character alone were used to separate them. However, in Hawaii those species having a large scutellum which extends to the apex of the abdomen and conceals the membranous parts of the hemelytra belong to the Scutellerinae, and all our Pentatominae have a shorter scutellum which does not reach the apex of the hemelytra and encroaches only slightly upon the membranous parts of the wings which are exposed, and we can use these characters for the separation of our species.

Subfamily SCUTELLERINAE

Scutelleridae, of authors.
Thyreocoridae, in Fauna Hawaiiensis, in part.

The Shield Bugs

The scutellum in this group is unusually large; it reaches the apex of the abdomen and completely conceals the membranous parts of the wings in our species. The subfamily can be distinguished from the Pentatominae in Hawaii at a glance, because of the large shield-like scutellum. Some workers consider this group to be a family distinct from the Pentatomidae.

Genus **COLEOTICHUS** White, 1839

This genus is widespread in Oceania and contains many large and elegant bugs.

Coleotichus blackburniae White (figs. 6, 7).

Coleotichus blackburniae White, 1881:52.
Kirkaldy, 1902:172, pl. 5, fig. 49; 1907:144–145, early stages.

The koa bug.

Endemic. Kauai, Oahu (type locality: near Honolulu), Molokai, Lanai, Maui, Hawaii.

Hostplants: feeds principally on the pods and seeds (and evidently even on dried but moist pods) of *Acacia koa*; also on some other species of *Acacia* and on *Dodonaea.*

This magnificent bug is by far the most spectacular of the Hawaiian Heteroptera. It is about three-fourths of an inch long and is the most bulky and most brilliantly colored of all our native bugs (it is exceeded in length in Hawaii only by the immigrant *Triatoma*). There are three principal color phases, the most common of which is predominantly brilliant green above with red markings; the colors of the

next most abundant color phase are reversed in dominance; the third form, which may be attached to *Dodonaea,* has considerable yellow coloring. Some specimens are almost entirely green, others almost entirely red above, and some appear to have an iridescent "frosting." The bug is often found in large colonies on *Acacia koa,* and occasionally it is found on koa trees in the city of Honolulu, but it is now really a forest insect. However, in the early days it was found even in hot and dry localities near sea level and to five or six thousand feet in the mountains (see Perkins, 1913:cxcii).

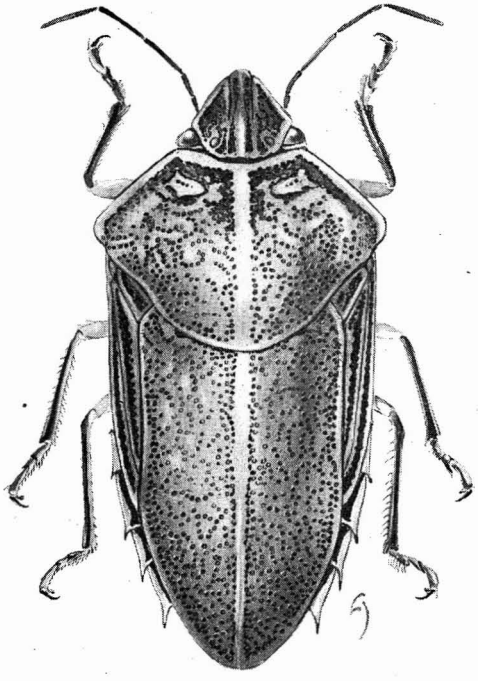

Figure 6—*Coleotichus blackburniae* White, the koa bug. (Abernathy drawing.)

Both adults and nymphs are frequently gregarious, lying packed close together, when at rest. Great numbers are sometimes in consequence found together, and a single tree may hold some hundreds of specimens of adults and nymphs of all sizes, as well as many eggs. The adults appear to be on the wing at night, and occasionally enter houses, attracted by the light. However, they take flight very readily on slight disturbance in the daytime, especially during hot sunshine, usually flying a short distance, and making a loud humming noise as they fly. Sometimes after a short circular flight they return to the tree from which they were disturbed. They are very partial to Koa trees (*Acacia koa*), but feed, so far as I have observed, only upon the pods of these, extracting their juices. Whether they will attack other parts in the absence of pods is very doubtful. They breed likewise very freely on a very different tree, *Dodonaea viscosa,* and both eggs and nymphs are occasionally found on other plants. The two mentioned trees are, however, their favourite food-plants. They have also been found breeding on imported Acacias. Usually from *Dodonaea viscosa* I have obtained the yellow form, with clear yellow dorsal stripe, untinged with red, from *Acacia koa* the red form. Whether these varieties depend entirely on the food-plant is, however, uncertain; it is perhaps more likely

due to climate, the yellow variety being chiefly found in the driest localities. It is a remarkable fact that the little Lycaenid butterfly, *Lycaena blackburni,* which holds a position in the Hawaiian Lepidopterous fauna somewhat analogous to that of *Oechalia* [error for *Coleotichus.* E.C.Z.] in the Heteroptera, feeds either in the pods of *Acacia koa,* or on the *Dodonaea* with equal readiness and, so far as is known, on no other native trees. The small, globular nymphs of the first stage are very conspicuous objects from the strong contrast of their colours, the abdomen being for the most part bright red. (Perkins, 1913: cxcii–cxciii.)

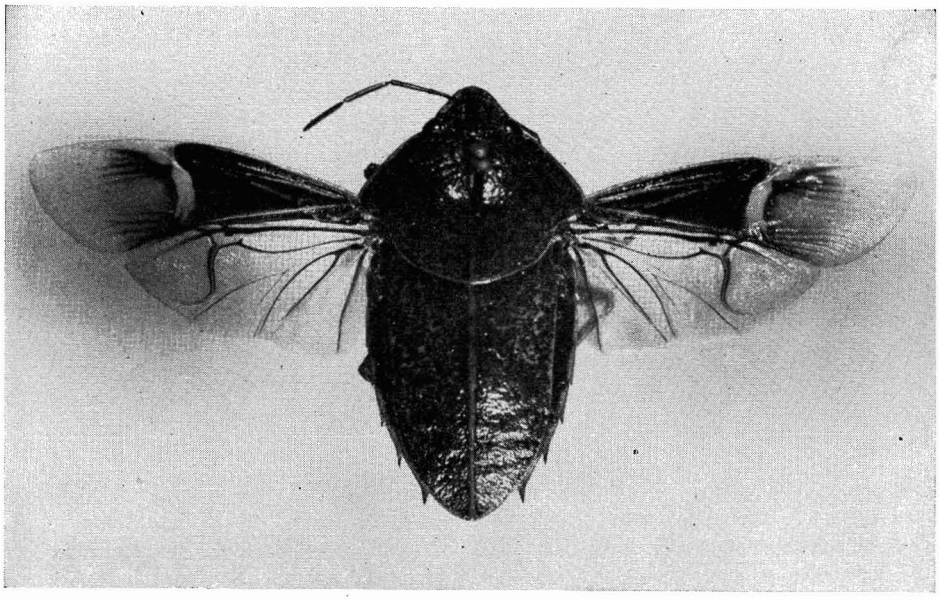

Figure 7—*Coleotichus blackburniae* White, the koa bug.

The golden-green or creamy-white eggs are minutely granular and not conspicuously sculptured. They are usually deposited in groups on the pseudo-leaves of *Acacia koa.* The nymphs are marked with red and black and dark blue. When disturbed the adults fly swiftly away with a loud buzzing sound and do not feign death as do the species of *Oechalia.*

This beautiful insect was named for Mrs. Blackburn, the wife of Reverend Thomas Blackburn, pioneer Hawaiian entomologist.

Subfamily PENTATOMINAE (Leach, 1815)

Cimicidae, in Fauna Hawaiiensis.

The Stink Bugs

Antennae five-segmented; rostrum four-segmented; two ocelli present. The large scutellum reaches the wing membrane, the corium is large and heavily sclerotized; the membrane reaches the apex of the abdomen and has several veins, some of which are forked. The tarsi are three-segmented in our species.

This family obtains its common name from the fact that the bugs can exude a strong musk which is unpleasant to the taste and smell. In some places certain species befoul such fruits as berries with their obnoxious odor. The group is cosmopolitan in distribution and is second only to the Miridae in the number of described species. Our native fauna, however, contains only a single genus. Most of the species are plant feeders and in many places in the world there are important plant crop pests in this family. One of these pests has become established in Hawaii. In the western Pacific, as in the tropical and subtropical regions of the Orient, America and Africa, the family has many extraordinary and beautiful members. The group reaches its greatest development in the Oriental regions. The highly decorated eggs are objects of beauty themselves, and are possibly the most ornate of all insect eggs. (See Esselbaugh, 1946, for a study of the eggs of a number of species.)

Key to the Tribes Found in Hawaii

1. Ventrite two unarmed..... **Pentatomini.**
2. Ventrite two (apparently ventrite one) with a large, conspicuous spine projecting forward between the coxae..... **Asopini.**

Tribe PENTATOMINI (Stål, 1864)

This tribe is represented in our fauna by one accidentally introduced species.

Genus **MURGANTIA** Stål, 1862

The headquarters of this genus is in South America.

Murgantia histrionica (Hahn) (figs. 8, 9).

Strachia histrionica Hahn, 1834:116, pl. 45, fig. 196.

The harlequin cabbage bug.

Kauai, Oahu.

Immigrant. A native of Central America. First found in the Hawaiian Islands by Swezey at Ewa Coral Plain, Oahu, in 1924. Ehrhorn intercepted the species in quarantine at Honolulu in furniture packing material in 1917 or 1918. First taken on Kauai by S. Au in 1942 at Koloa.

Hostplants: broccoli, *Capparis sandwichiana,* cauliflower, Chinese cabbage, head cabbage, nasturtium.

Parasite: *Ooencyrtus johnsoni* (Howard) (Hymenoptera: Encyrtidae), purposely introduced from the United States.

This species has not become the pest of crucifers in Hawaii that it has in North

America, where its ravages attain serious proportions, but it is gradually spreading here and may become of more importance in the future. It was confined to *Capparis* on Ewa Coral Plain for many years, but it has recently extended its range and has begun to show up in gardens.

This bug is about three-eighths of an inch long when adult and is strikingly colored black and orange. The large eggs are cylindrical and resemble small barrels. They are white with conspicuous black rings, and a single small black spot

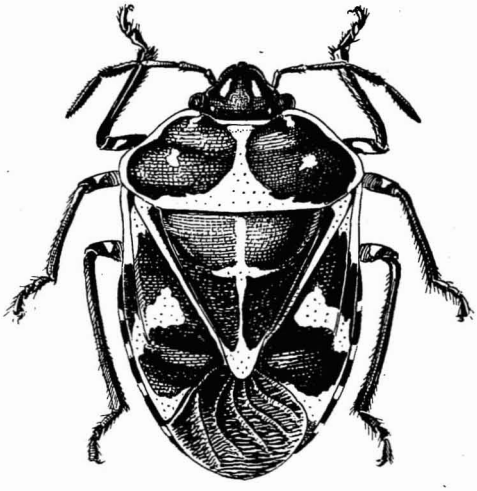

Figure 8—*Murgantia histrionica* (Hahn), the harlequin cabbage bug. (Abernathy drawing.)

resembling a bunghole is situated on the lower ring. Usually about a dozen eggs are laid on the under surfaces of the leaves, somtimes in two parallel rows of six eggs each. Each female may lay several such batches. The nymphs are colored black and orange or red. There are, as usual, five nymphal instars; the nymphs have only four antennal segments instead of the adult complement of five. The complete bionomics have not yet been reported on in Hawaii. Perhaps the entire life cycle may be passed within six to eight weeks here.

The feeding of these insects causes white blotches to appear on the leaves, and the plants may wither and die if severely attacked.

Control: The following methods of control have been recommended by the United States Department of Agriculture (1940):

Practice clean cultural methods throughout the season. Disk and plow under all stalks and other refuse as soon as the crop has been harvested. The growing of trap crops, hand picking, and the use of the blow torch are also effective methods of keeping down the number of bugs.

Control by insecticides is recommended only after preventive measures to reduce the numbers of the insects have been followed.

Spray or dust with derris or cube.

Use 1½ pounds of derris or cube root powder (containing 4 percent of rotenone) with a spreader and wetting agent in 50 gallons of water; or, in smaller quantities, 1½ ounces (10 level tablespoonfuls) with a spreader and wetting agent in 3 gallons of water.

For dusting, use a derris or cube dust containing 0.75 percent of rotenone. To prepare this dust, use 15 ounces of finely ground root (having a 4-percent rotenone content) to 4 pounds and 1 ounce of the diluent (finely ground talc, clay, sulfur, tobacco, or other powder except lime), or 18¾ pounds of the root to 81¼ pounds of the diluent. If the rotenone content of the derris or cube is greater or less than 4 percent, the proportions of the inert diluent must be varied accordingly.

Begin spraying or dusting when the bugs first appear and repeat the treatments as often as necessary.

See also White and Brannon, 1939:1–10, figs. 1–6.

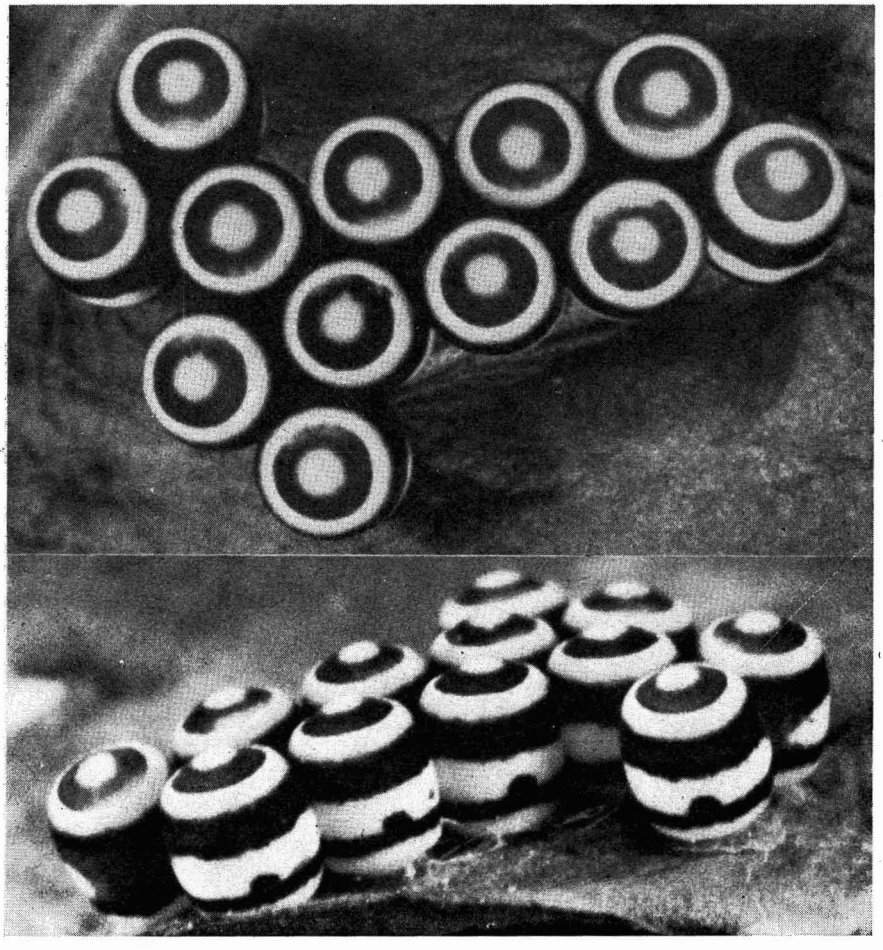

Figure 9—Two views of a cluster of the black-and-white eggs of the harlequin cabbage bug, *Murgantia histrionica* (Hahn), on a cauliflower leaf.

Tribe ASOPINI (Spinola, 1850)

In contrast to the plant-feeding habits of most of the pentatomids, the members of this tribe are predaceous on insects such as caterpillars and aphids and other Homoptera. They are, therefore, beneficial insects.

Genus **OECHALIA** Stål, 1862

Redescription and monograph by Usinger, 1941:59.

This peculiar genus contains 15 species, 14 of which are found in Hawaii and one which is widespread from Australia to southeastern Polynesia. The genus has been in a state of chaos for many years, and most of the literature of the present century is in a sad state of confusion. However, Usinger (1941:59) has published recently a monograph of the genus with detailed descriptions and noteworthy discussion, and he has straightened out the group in a scholarly manner.

The extra-Hawaiian species and genotype, *Oechalia consocialis* (Boisduval), has a few characters which differ from all the Hawaiian species, and Kirkaldy (1909) separated the Hawaiian species from it subgenerically.

Subgenus **Hawaiicola** Kirkaldy, 1909:83

This subgenus is separated from *Oechalia, sensu stricto,* because it has a well-developed lobe on either side of the prosternum instead of feebly developed lobes, and the spine of the second abdominal segment extends beyond the middle coxae instead of reaching only between them.

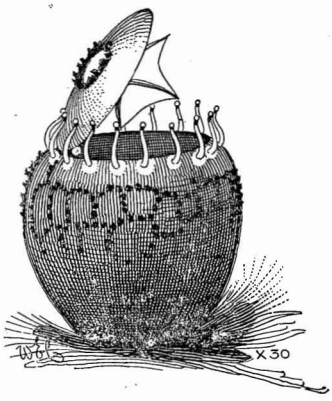

Figure 10—An egg of an *Oechalia* after the emergence of the nymph. (After Kirkaldy, 1907.)

The species of this group are fast flyers, but they usually remain quiet, drop off the hostplant or feign death if disturbed. However, they sometimes "buzz" about with great speed in one's net. They are among the finest of our native bugs, some species are not uncommon and they are a beneficial group. They are true forest insects, but now and again specimens may wander into the lowlands;

Perkins reported that in his time certain species were common in the lowlands where there was green vegetation. However, the species have become much rarer since Perkins was here. During the time when the sugarcane leafhopper was abundant and doing serious damage, at least one of the species of *Oechalia* (*kaonohi*) invaded some of the sugarcane fields to prey upon the leafhoppers. They attack fairly large caterpillars, such as leaf rollers and loopers, and it is interesting to watch them impale a caterpillar on their outstretched beaks, lift its carcass or carry it about and then discard its withered remains after its juices are sucked out. *Scotorythra, Plusia* and various other pyralid and geometrid caterpillars evidently form the principal food supply of the genus.

The types of *kaonohi* Kirkaldy, *hirtipes* Van Duzee and *virgula* Van Duzee, as well as all of Usinger's types, excepting *sinuata* which is in the U. S. National Museum, are in Honolulu. Stål's types of *patruelis* and *pacifica* and Burmeister's *grisea* are in Europe.

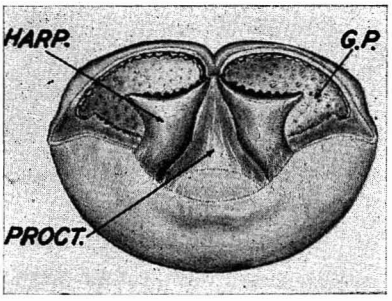

Figure 11—*Oechalia pacifica* (Stål) : caudal view of male genital capsule showing the genital plates (**G.P.**), harpagones (**HARP.**) and proctiger (**PROCT.**). (After Usinger, 1941.)

Key to the Hawaiian Species of Oechalia

(Recast from Usinger, 1941 :72–73)

1. Humeri strongly produced into straight or slightly sinuate, acute or subacute, spines which extend about one-eighth of total width of pronotum beyond bases of hemelytra.... 2
   Humeri only briefly, roundly or subangulately produced, extending one-eleventh or less of total width of pronotum beyond bases of hemelytra..... 8

2(1). Ground color ferrugineous, marked with usual fuscous to black punctures and with scutellum pale at apex; legs densely clothed with long, erect hairs, those of femora about two-thirds as long as thickness of femora; abdominal spine reaching middle of mesosternum, tapering and subrounded at apex and bent feebly downward apically; genital plates less than one-third width of capsule; harpagones feebly dilated apically, width across tips of arms three-fifths as great as that of genital plate; Hawaii ..... **hirtipes** Van Duzee.
   Ground color never distinctly ferrugineous; hairs of legs shorter or less dense 3

3(2). Upper surface distinctly tinged with green; abdominal spine reaching middle of mesosternum, tapering, rounded at apex and bent downward; genital plates less than one-third width of capsule; harpagonal arms well developed, especially ectal one; width across arms three-fourths that of genital plates; Kauai ..... **virescens** Usinger.

Upper surface never tinged with green..... 4

4(3). Legs usually red; abdominal spine very long and slender, nearly reaching front coxae, bent downward toward apex; genital plates large, one-third width of genital capsule; harpagonal arms feebly produced, width across arms one-half to two-thirds that of genital plates; Oahu ..... **patruelis** (Stål).

Legs ochraceous or fulvous; male terminalia not so formed.. 5

5(4). General coloration usually appearing as pale brown because of extensive ochraceous ground color and fuscous punctures; genital plates a little less than one-third as wide as capsule; harpagonal arms strongly produced, four-fifths as wide across apices as width of genital plates; Kauai and Oahu ..... **grisea** (Burmeister).

General coloration usually darker; harpagones less strongly dilated apically; Hawaii 6

6(5). Humeral angles strongly sinuate; genital plates large, a little more than one-third as wide as capsule; harpagones asymmetrical, ectal arms entirely wanting and width at apex only one-third that of genital plates; Hawaii..... ..... **virgula** Van Duzee.

Humeral angles less strongly sinuate or straight; genital plates relatively smaller and harpagones more symmetrical 7

7(6). Upper surface with extensive dark areas; humeri straight; abdominal spine relatively short, almost reaching middle of mesosternum; size relatively large, 11.5 to 12 mm.; genital plates less than one-third as wide as capsule; harpagonal arms moderately produced, two-thirds as wide across apices as width of genital plates; slopes of Mauna Loa, Hawaii ..... **acuta** Usinger.

Upper surface with less extensive dark areas; humeri feebly sinuate; abdominal spine long and slender, reaching front coxae; size smaller, 9.5 to 11 mm.; genital plates less than one-third as wide as capsule; harpagonal arms about two-thirds as wide across apices as width of capsule; slopes of Mauna Kea, Hawaii..... **bryani** Usinger.

8(1). Body long and slender, nearly two and one-half times as long as broad, 11:4.5; pronotum relatively narrow, humeri extending only about 1/32 of total width of pronotum beyond bases of hemelytra, little more than twice as broad across humeri as long, 95:45; abdominal spine reaching a little beyond middle of mesosternum, nearly

straight, apex angulate at least dorsally; genital plates slightly more than two-thirds as wide as capsule; harpagonal arms strongly asymmetrically produced, distance across apices nearly as great as width of genital plates, 19:18; Hawaii, Maui, Kauai.....**kaonohi** Kirkaldy.

Body form shorter and broader, never more than twice as long as broad; pronotum broader, humeri extending one-twelfth to one-eighteenth of total width of pronotum beyond bases of hemelytra; harpagonal arms never so strongly produced 9

9(8). Color in great part ferrugineous; humeri moderately, angulately produced, extending about one-eleventh or one-twelfth of total width of pronotum beyond bases of hemelytra; second antennal segment longer than fifth.....10

Color light or dark brown; humeri shorter, extending only one-fourteenth or one-sixteenth of total width of pronotum beyond bases of hemelytra.....11

10(9). Antero-lateral margins of pronotum strongly sinuate; scutellum with middle and apex ivory-white and with fuscous punctures; Oahu .....**sinuata** Usinger.

Antero-lateral margins of pronotum not strongly sinuate; scutellum without distinct white areas; Hawaii.....
.....**ferruginea** Usinger.

11(9). Coloration pale brown, ground color testaceous with pale-brown punctures; abdominal spine short, only reaching middle of mesosternum, tapering to briefly rounded apex; humeri very briefly but angularly produced; genital plates small, about one-fourth as wide as capsule; harpagonal arms distinctly produced, five-sixths as wide across apices as width of genital plates; Oahu, Molokai, Maui .....**swezeyi** Usinger.

Color usually darker; abdominal spine long and slender, nearly reaching front coxae, bent downward at tip.....12

12(11). Upper surface nearly concolorous, generally fusco-ferrugineous with pale areas, including apex of scutellum, only faintly indicated; humeri very short, extending about one-sixteenth of total width of pronotum beyond bases of hemelytra; genital plates small, one-fourth as wide as capsule; harpagones five-sixths as wide across apices of arms as width of genital plates; Maui.....
..... **suehiroae** Usinger.

Upper surface brownish to nearly black with sharply contrasting white markings, particularly on apex of scutellum; humeri usually, but not always, a little more produced, extending one-fourteenth of total width of pronotum beyond bases of hemelytra.....13

13(12). Genital plates less than one-third as wide as capsule, 14:50; harpagonal arms scarcely produced, apices of harpagones triangular in shape, less than half the width of genital

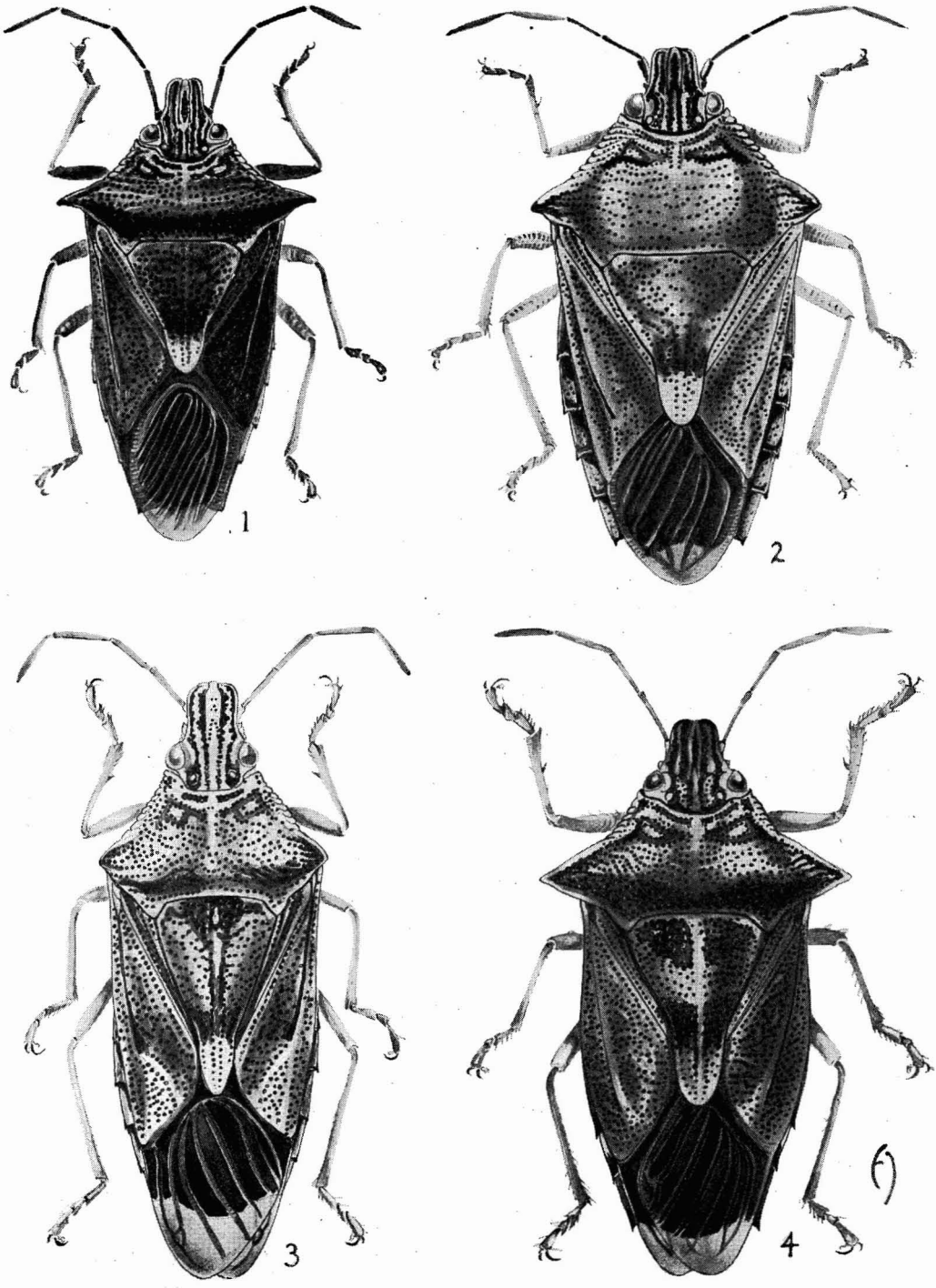

Figure 12—Four species of *Oechalia*: 1, *Oechalia virescens* Usinger; 2, *Oechalia pacifica* (Stål); 3, *Oechalia kaonohi* Kirkaldy; 4, *Oechalia grisea* (Burmeister). (Abernathy drawings.)

plate, 6:15; known only from Kula Pipe Line, 4,500 feet, Maui ..... **similis** Usinger.

Genital plates larger, two-fifths as wide as capsule, 19:47; harpagones strongly asymmetrical, ental arms produced upward almost as continuations of inner edges while ectal arms are bent abruptly outward; width measured obliquely across apices of arms about three-fifths width of genital plates, 12:19; Kauai, Oahu, Molokai, Lanai, Maui ..... **pacifica** (Stål).

Each of the following species is fully described or redescribed in Usinger's monograph. Some of Van Duzee's species were described from series of specimens which included more than one species and some of his descriptions, therefore, are unreliable.

Oechalia acuta Usinger (fig. 13).
Oechalia acuta Usinger, 1941:82.

Endemic. Hawaii (type locality: Kilauea).
"A large dark colored species with straight, acute humeral spines as in *hirtipes* but with less hairy legs, slightly different male genitalia, and with ferrugineous color." (Usinger, 1941:82.)

Oechalia bryani Usinger (fig. 13).
Oechalia bryani Usinger, 1941:81.

Endemic. Hawaii (type locality: Hookomo, Mauna Kea, 8,500 feet).
Hostplant: *Sophora.*
"Closely allied to ... *hirtipes* and *virgula*.... However the former is ferrugineous in color and has numerous long erect hairs on the legs and the latter has the harpagones strongly narrowed apically.... This species is smaller than the other species from Hawaii with the abdominal prolongation longer, the legs less hairy, and the humeri bent slightly but distinctly backwards." (Usinger, 1941: 81, 82.) This is an ochraceous species with dark-brown to black punctures.

Oechalia ferruginea Usinger (fig. 13).
Oechalia ferruginea Usinger, 1941:85.

Endemic. Hawaii (type locality: Kilauea, 4,000 feet).
"This is the only member of the group of species with subrounded humeri known to occur on Hawaii. The humeri are more strongly produced than in other members of the group and the color is ferrugineous." (Usinger, 1941:85.) This species shares with *sinuata* the distinction of being one of the two species which have the second antennal segment longest and the fifth segment shortest.

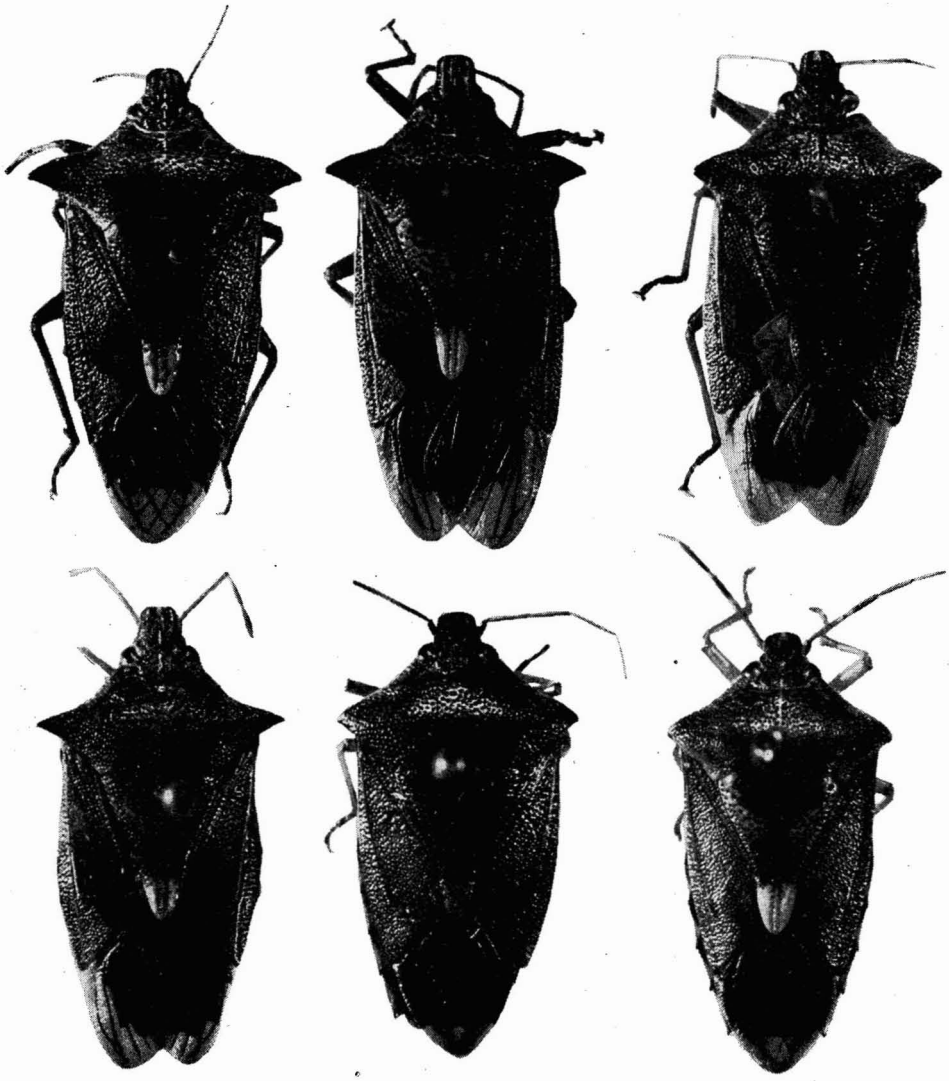

Figure 13—Some species of *Oechalia*: top row, left to right, *O. acuta* Usinger; *O. bryani* Usinger; *O. ferruginea* Usinger, paratype. Bottom row, left to right, *O. hirtipes* Van Duzee, allotype; *O. suehiroæ* Usinger; *O. similis* Usinger, allotype.

Oechalia grisea (Burmeister) (fig. 12).

Asopus griseus Burmeister, 1834:293; 1835:360.

Oechalia grisea (Burmeister) Stål, 1862:93; 1870:59. Usinger, 1941:76, redescription.

Endemic. Kauai, Oahu (type locality).

The confusion that existed in the classification of the genus before Usinger's monograph resulted in this specific name being used as a "dumping ground" for

various and sundry records of different species of the genus. Swezey (1942:199) has made some corrections in the early literature.

This is a pale-brown appearing species which is basically ochraceous with black or fuscous punctures.

Oechalia hirtipes Van Duzee (fig. 13).

Oechalia hirtipes Van Duzee, 1936:221. Usinger, 1941:85, redescription.

Endemic. Hawaii (type locality: Kilauea).

"A species with strongly produced, acute humeri and a general ferrugineous color over most of the body." (Usinger, 1941:85.)

Oechalia kaonohi Kirkaldy (fig. 12).

Oechalia kaonohi Kirkaldy, 1909:83, text fig. *b,* male genitalia, pl. 2, fig. 1. Usinger, 1941:91, redescription.

Endemic. Kauai(?), Maui, Hawaii (type locality: Naalehu).

This species "is one of the most distinctive species in the genus, the long slender form and very broad harpagonal arms being unique among the species of *Oechalia* known to me. This is the species which Swezey (1905) studied and illustrated under the name *grisea.* Kirkaldy later described it as a new species but the original name, *grisea,* has since been used by Williams (1931) and Swezey (1936) who reprinted the original plate of illustrations. I can find no specimens of this species collected during the past twenty-five years." (Usinger, 1941:92.) It is peculiar that this species should have been abundant and invaded certain upland sugarcane fields in numbers to attack the sugarcane leafhopper when that insect was at its height and yet not be represented in the collections assembled in the last quarter of a century. It also feeds on *Omiodes accepta.* The isolated Kauai record should be checked carefully.

Oechalia pacifica (Stål) (figs. 11, 12).

Arma pacifica Stål, 1859:221.

Oechalia pacifica (Stål) Stål, 1870:59.

Kirkaldy, 1909:83, pl. 2, fig. 2 (under *grisea*). Usinger, 1941:86, redescription, fig. 1, male terminalia.

Endemic. Kauai, Oahu (type locality), Molokai, Lanai, Maui.

This blunt-shouldered species is highly variable as well as widespread. It is unusual that it has not been found on the island of Hawaii. Occasionally it is found in the lowlands. It has been seen feeding on larvae of the immigrant leaf beetle *Lema trilineata californica* Schaeffer.

Oechalia patruelis (Stål) (fig. 14).

Arma patruelis Stål, 1859:220.

Oechalia patruelis (Stål) Stål, 1870:59. Usinger, 1941:62–66, pl. 1, bionomics; 80, redescription.

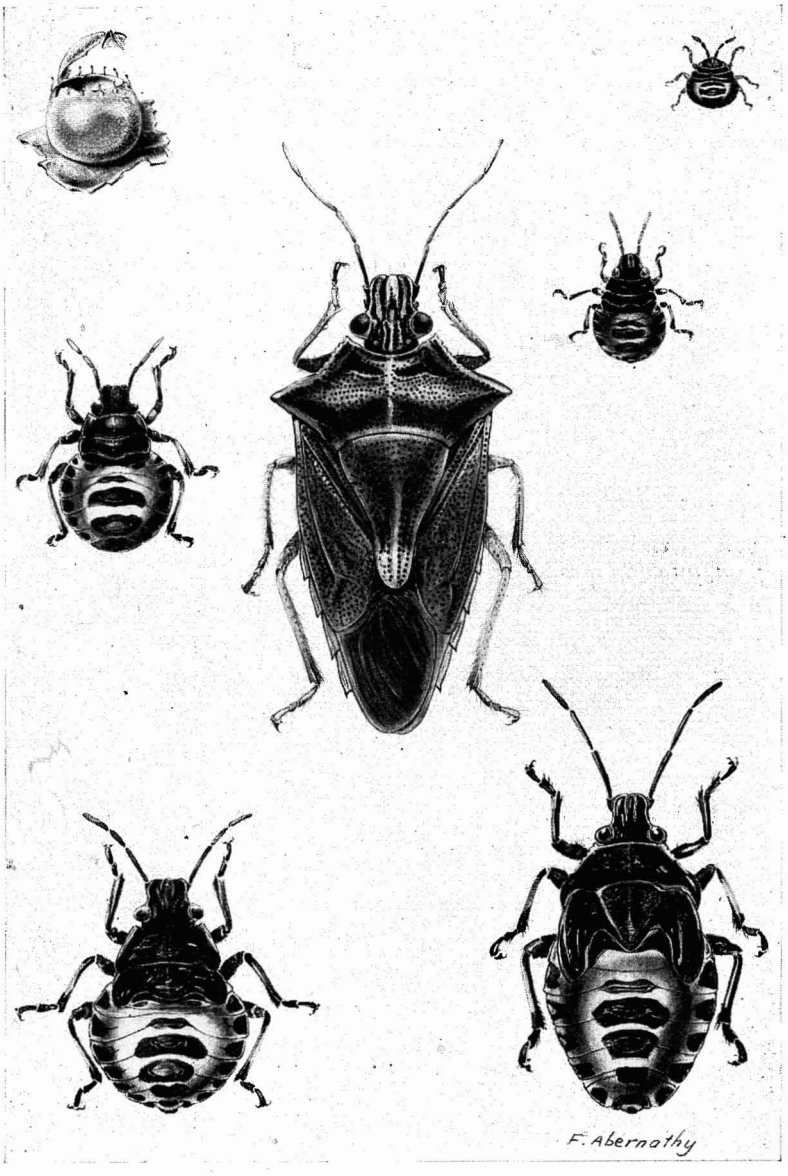

Figure 14—*Oechalia patruelis* (Stål): hatched egg, five nymphal stages and adult. (After Usinger, 1941.)

Endemic. Oahu (type locality: Honolulu).

"Allied to *grisea* and occurring together with that species on the island of Oahu. As in *grisea* the humeral angles are strongly produced and acute but the legs are usually red in color and the harpagones are much less expanded at their tips, being only half as wide as the large genital plates." (Usinger, 1941:80.)

Usinger studied the life history of this species in detail and raised three generations starting with the eggs of one female. The following summary is from his account. A clutch of 14 subrotund eggs were cemented to the under side of a *Coprosma* leaf. The newly laid eggs, which are about 1 mm. thick, are pale cream in color but soon darken to olive-green or fuscous and bear from seven to eleven conspicuous, capitate, threadlike processes around the upper edge near the margin of the operculum. The eggs hatch in eight days. The operculum retains on its inner side the "egg burster" so typical of the Pentatomidae (see the illustration). The first instar nymphs are gregarious; they molt in seven or eight days. The other instars were found to have the following average durations: second, four days; third, three days; fourth, eight days; fifth, eight days. Copulation occurred eight days after the final nymphal molt and eggs were laid six days thereafter. Thus the life cycle from egg to egg may be about two months. For detailed descriptions of the nymphal stages, see Usinger's monograph.

Oechalia similis Usinger (fig. 13).
Oechalia similis Usinger, 1941:88.

Endemic. Maui (type locality: Kula Pipe Line, 4,500 feet).
"Very similar to *pacifica* but with the male harpagones slender, beveled to a sharp edge at apices as in *virgula* from Hawaii." (Usinger, 1941:88.)

Oechalia sinuata Usinger.
Oechalia sinuata Usinger, 1942:217.

Endemic. Oahu (type locality: Mount Kaala).
Hostplant: *Metrosideros.*
"Allied to *ferruginea* Usinger from the island of Hawaii but with strongly sinuate antero-lateral margins of pronotum, sharply contrasting pale and dark areas on the scutellum, and a short, broad body form." It "differs from all other described Oechalias in the type of maculation and in degree of sinuation of antero-lateral pronotal margins." (Usinger, 1942:217–218.)
I have not seen this species.

Oechalia suehiroae Usinger (fig. 13).
Oechalia suehiroae Usinger, 1941:89.

Endemic. Maui (type locality: Haleakala, 5,000 feet).
"Allied to *pacifica* with similar rounded apices of humeri but brownish ferrugineous in color and with the male genital plates scarcely wider than the strongly dilated apices of harpagones." (Usinger, 1941:89.)

Figure 15—*Oechalia swezeyi* Usinger, allotype, left. *Oechalia virgula* Van Duzee, paratype, right.

Oechalia swezeyi Usinger (fig. 15).
Oechalia swezeyi Usinger, 1941:90.

Endemic. Oahu, Molokai (type locality: Kanoa), Maui.
This species is "rather uniformly pale, whitish testaceous with brown punctures." It "may be separated from all others by its briefly produced, rounded humeri, pale coloration, and small genital plates with relatively strongly dilated harpagones." (Usinger, 1941:91.)

Oechalia virescens Usinger (fig. 12).
Oechalia virescens Usinger, 1941:77.

Endemic. Kauai (type locality: Kokee).
Hostplants: *Scaevola, Straussia.*
"Allied to *grisea* and *patruelis* with humeri as strongly produced and sharp as in those species. Male genitalia small, the harpagones nearly as wide as the genital plates, as in *grisea.* Upper surface entirely or in great part suffused with green." (Usinger, 1941:77.)

Oechalia virgula Van Duzee (fig. 15).

Oechalia virgula Van Duzee, 1936:220. Usinger, 1941:83, redescription.

Endemic. Hawaii (type locality: Puuwaawaa, 3,700 feet).

Hostplants: *Dodonaea, Myoporum.*

"Very similar in general appearance to *grisea* and *patruelis* with similar sharp humeri but with fulvous or paler legs bearing longer and more numerous erect femoral hairs and with the harpagones very slender, actually narrowed or compressed at the tip rather than expanded as in all other known Oechalias except *similis.*" (Usinger, 1941:83.)

Family **COREIDAE** (Leach, 1815) Samouelle, 1819

The Squash Bugs

The Coreidae have a lygaeid-like facies, the antennae are four-segmented, the rostrum has four segments and the tarsi are three-segmented; two ocelli are present, and the wing membrane has numerous, anastamosing veins.

This is a large, herbivorous family which contains elsewhere numerous economically important species, but, fortunately, we have none of the serious pest species in Hawaii. Only two genera are found here—one is endemic and the other is represented by a widespread immigrant species.

NOTE: While this volume was in proof, details of the discovery of a new immigrant coreid have been announced. This new addition to the fauna, *Coriscus pilosulus* (Herrich-Schaeffer), is discussed and illustrated on page 237.

KEY TO THE GENERA OF COREIDAE FOUND IN HAWAII

1. Hind femora without spines beneath; head much broader across eyes than its length.....**Liorhyssus** Stål.
2. Hind femora armed on lower side with conspicuous spines; head as long as or longer than broad.....**Ithamar** Kirkaldy.

Subfamily RHOPALINAE (Amyot and Serville, 1843) China, 1943

Genus **LIORHYSSUS** Stål, 1870

This widespread genus contains many species.

Liorhyssus hyalinus (Fabricius) (fig. 16).

Lygaeus hyalinus Fabricius, 1794:168. Genotype, fixed by Reuter.

See Van Duzee, 1917:120–121, for synonymy. The generic names *Corizus* and *Rhopalus* have also been used for this species in Hawaiian literature.

Kirkaldy, 1907:146, bionomics.

The hyaline grass bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Immigrant. Almost cosmopolitan. First recorded from the Hawaiian Islands by Kirkaldy (1902:170) from specimens collected on Oahu and Hawaii. Probably an early immigrant to the islands, although Blackburn did not collect it.

Hostplants: *Euphorbia cordata, Gossypium tomentosum* (native cotton), *Malva, Reichardia picroides, Sida cordifolia, Sonchus oleraceus.* Feeds upon stems and unopened flower buds.

Parasites: *Microphanurus paractias* (Perkins) and *Microphanurus rhopali* (Perkins) (Hymenoptera: Scelionidae) in the eggs; *Paradionaea* (*Leucostoma*) *atra* (Townsend) (Diptera: Tachinidae) on the adults.

Predator: *Zelus renardii* Kolenati (Hemiptera: Reduviidae).

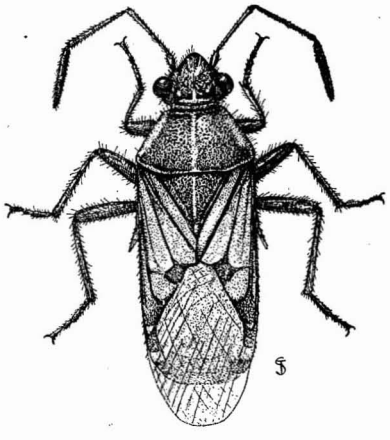

Figure 16—*Liorhyssus hyalinus* (Fabricius). (After Williams, 1931.)

The red, reniform, millimeter-long eggs are laid in clusters, usually on the leaves or in the flowers of the hostplant. I have seen 14 eggs deposited as a mass in a flower head of *Sonchus oleraceus,* the insect's favorite food plant. Kirkaldy (1907: 146–148) noted that an end-to-end position was assumed in copulation, that the usual clutch of eggs is 20 to 25, that the females lay more than one batch of eggs and re-copulate after oviposition. The incubation period is six to seven days, with the five nymphal instars taking only about two weeks. The nymphs gradually change color from largely red in the first instar to largely "yellowish-green testaceous" in the fifth. Kirkaldy (1907:146–148) describes the nymphal instars.

Van Zwaluwenburg (*Proc. Hawaiian Ent. Soc.* 12[1]:23, 1944) found that egg incubation averaged a little more than five days (125 hours) at an average mean temperature of 78.2° F. Fifteen to 16 days were required for the course of five instars. Oviposition occurred between 72 and 78 hours after the insects attained adulthood, and a complete generation, from adult to adult, took 23 or 24 days. A bred female laid 387 eggs on 32 consecutive days (average 12 per day), and lived 35 days.

Subfamily ALYDINAE Stål

Genus **ITHAMAR** Kirkaldy, 1902:169

This is an endemic genus whose genotype is *hawaiiensis*. Van Duzee (1936:222) stated that "It is closely related to *Harmostes* Burm. but may be distinguished by the depressed clypeus, the shorter bucculae and the less expanded pronotal margins which are unarmed before." *Harmostes* is an American genus. Not being

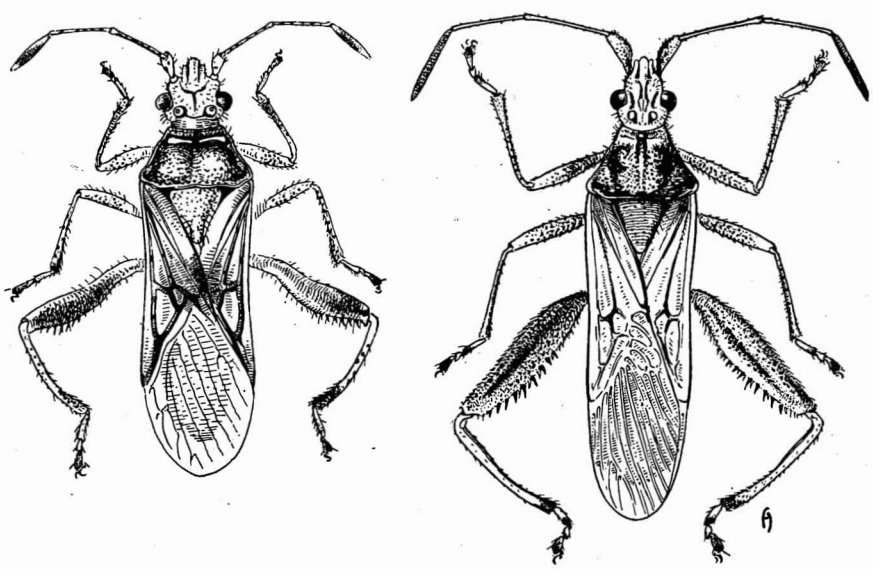

Figure 17—*Ithamar annectans* Van Duzee, left. *Ithamar hawaiiensis* Kirkaldy, right. (Drawn to same scale by Abernathy.)

satisfied with Van Duzee's conclusions, I requested an opinion from Mr. China, and he replied: "*Ithamar* is certainly not closely allied to *Harmostes* Burm. which is a Corizinid whereas *Ithamar* is an Alyinid, two very distinct subfamilies of Coreidae. *Ithamar* appears to be most closely related to the genus *Daclera* Signoret 1863, which has a curious distribution, Reunion Is. (S. Indian Ocean near Madagascar), S. India and Australia. Of course *Ithamar* is very distinct from *Daclera* but the two genera may possibly have had a common origin and are primitive members of the subfamily."

KEY TO THE SPECIES OF ITHAMAR

1. Ocelli situated distinctly behind a line connecting posterior edges of eyes; juga produced and more or less tuberculiform distad and on a level distinctly higher than tylus which is submerged between them distad.....**hawaiiensis** Kirkaldy.

2. Ocelli situated on a line connecting posterior edges of eyes; tylus on a level higher than juga which are not produced.. .....**annectans** Van Duzee.

Ithamar annectans Van Duzee (fig. 17).

Ithamar annectans Van Duzee, 1936:222.

Endemic. Oahu, Maui (type locality: Iao Valley), Hawaii.

Hostplant: *Euphorbia.*

Ithamar hawaiiensis Kirkaldy (fig. 17).

Ithamar hawaiiensis Kirkaldy, 1902:170, pl. 5, fig. 46.

Endemic. Oahu, Molokai (type locality), Lanai, Maui, Hawaii.

Hostplants: *Euphorbia, Gossypium tomentosum, Sida cordifolia* ("ilima"), *Sophora, Styphelia* (*Cyathodes*).

The eggs, which are deposited in batches of five or more on the under surfaces of the leaves, and the first nymphal instar have been described by Kirkaldy (1907: 148–149).

It abounds on the coasts of some of these [islands], especially frequenting species of *Sida,* is common on the lower edge of the forests in open shrubby places, at 1500 to 3000 ft. above the sea, and again in open places in still higher forest, and far above this to a height of 9000 ft. At higher elevations it breeds on *Cyathodes.* Apparently it exhibits no noteworthy variation in any of these stations. Nymphs in all stages, eggs, and adults are found together on the plants named. The adults frequently wander elsewhere in their flight, and I have taken them in my garden in Honolulu. The hairy nymphs undergo conspicuous changes in the course of their development. This is probably the species that Blackburn supposed might be *Dysdercus peruvianus.* (Perkins, 1913:cxciii.)

This species is now rarely collected.

Family **LYGAEIDAE** (Shilling, 1829) Herrich-Schaeffer, 1835

Myodochidae, in Fauna Hawaiiensis.

The Chinch Bugs

This family is one of the largest of the Heteroptera. In Hawaii it shares with the Miridae the distinction of being one of the two most developed bug families in the islands. Many members of the group are crop pests in various parts of the world—some of them are of major importance. They are small or medium-sized bugs with the antennae and rostrum four-segmented, two ocelli are usually present, but are absent in some species (*Tempyra,* for example); the tarsi are three-segmented, and the claws have arolia; the veins of the wing membrane are reduced, there being not more than five, usually simple, veins. The species have well-developed scent glands and may emit an obnoxious odor.

KEY TO THE SUBFAMILIES OF LYGAEIDAE FOUND IN HAWAII

1. Hind margin of third ventrite not continued directly to dorso-lateral margins, but peculiarly curved anteriorly before sides ..... **Rhyparachrominae.**
   Hind margin of third ventrite normal, entire and similar to that of second 2

2(1). Eyes very large and extending postero-laterally around anterior corners of pronotum; abdominal spiracles on segments four, five and six lateral and visible from side..... ..... **Geocorinae.**
   Eyes not so formed; abdominal spiracles dorsal and not visible from side (do not mistake the glandular pores or opaque spots for spiracles) 3

3(2). Veins of hemelytral membrane distinct, second interior vein forked; clavus and corium smooth or roughened but not extensively set with distinct, separated, well-defined punctures ..... **Lygaeinae.**
   Veins of hemelytral membrane obsolete or, if present, second interior vein not forked; clavus and corium with distinct, conspicuous punctures ..... **Cyminae.**

Subfamily LYGAEINAE (Stål, 1862)

Three tribes of Lygaeinae occur in Hawaii, two of them represented by endemic species. The Metrargini are confined to Hawaii, and I feel that it is to be questioned whether the group should be given a rank equivalent to that of the other two tribes. Rather, I believe that its relationship would be more clearly indicated if the Metrargini were considered a subtribe of the Orsillini, for they appear to be an offshoot of that group.

KEY TO THE TRIBES OF LYGAEINAE FOUND IN HAWAII

1. Antenniferous tubercles, as seen from above, usually strongly produced forward as cone-like, spiniform processes on the antero-lateral corners; coxal flanges strongly punctate..... .....**Metrargini.**
   Antenniferous tubercles not so produced; coxal flanges not strongly punctured 2
2. Our species red and black; hind margin of corium straight and not sinuous .....**Lygaeini.**
   Not red and black species; hind margin of corium slightly sinuous, or at least not entirely straight along its posterior edge .....**Orsillini.**

Tribe LYGAEINI (Stål, 1872)

A single recently immigrant species represents this tribe in the Hawaiian Islands.

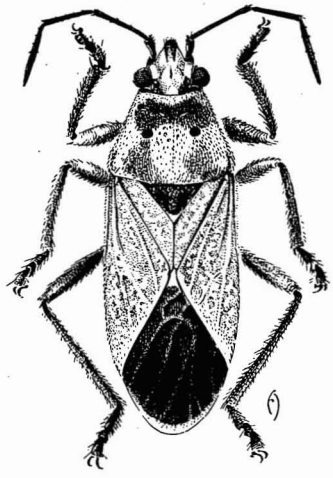

Figure 18—*Graptostethus manillensis* (Stål). (Abernathy drawing.)

Genus **GRAPTOSTETHUS** Stål, 1868

Graptostethus manillensis (Stål) (figs. 18, 19, 20).

Lygaeus manillensis Stål, 1859:240.

See China, 1930:115–116, and Usinger, 1947:107, for discussion.

Kauai, Oahu, Maui.

Immigrant. Known elsewhere only from the Philippines, with a closely related species (*nigriceps* Stål) on other Pacific islands, and another relative (*servus* [Fabricius]) on the Asiatic mainland. First found by Sakimura at Kunia, Oahu, in 1942 (Swezey, 1943:284, as *Graptostethus nigriceps*).

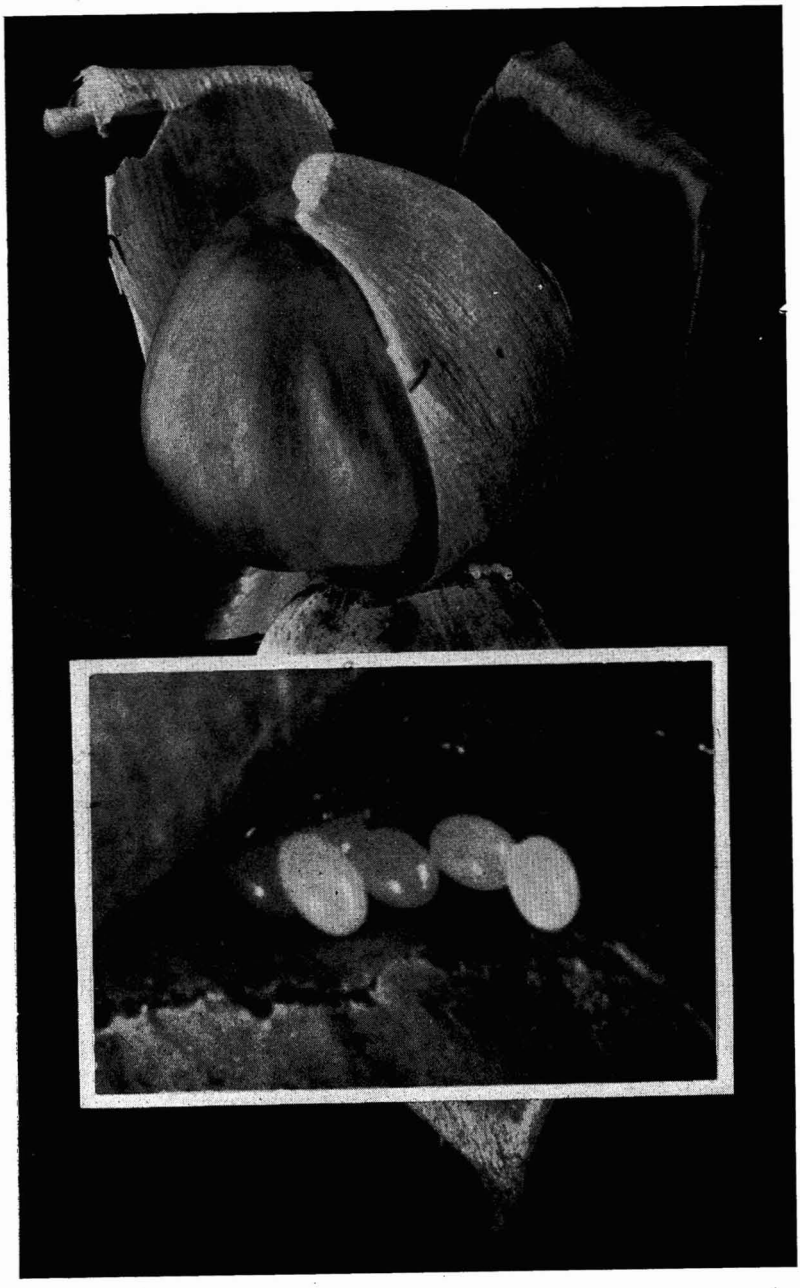

Figure 19—*Graptostethus manillensis* (Stål). Eggs in place at the base of a *Merremia tuberosa* capsule, and the same enlarged in inset. (After Swezey, 1945.)

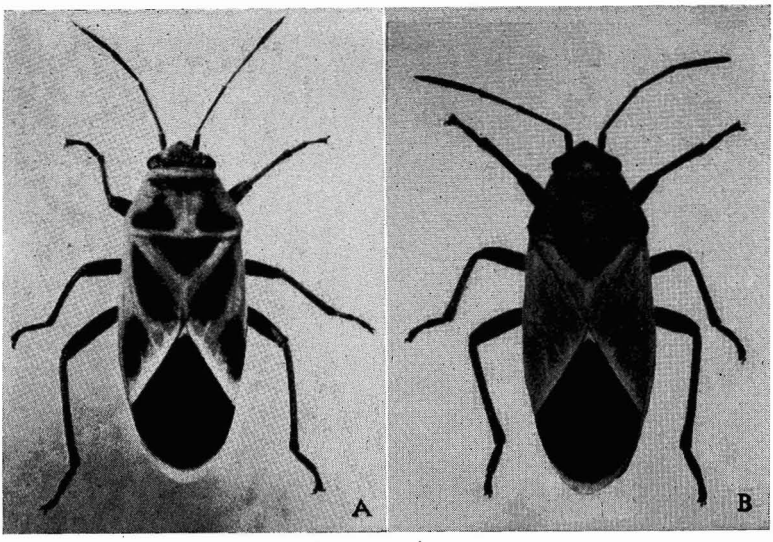

Figure 20—*Graptostethus manillensis* (Stål). Photographs of two color phases: **A,** the form with thorax, clavus and corium red with black markings; **B,** the form with thorax, clavus and corium mostly red. (After Swezey, 1945.)

Hostplants: *Ipomoea horsfalliae* (Kuhio vine), *Merremia* (*Ipomoea*) *tuberosa* (wood rose).

There is no other bug in Hawaii with which this striking species might be confused. Its red and black coloration is distinctive. There are two principal color forms: one has the hemelytra, excepting the membrane, immaculate and the pronotum has only two black dots; the other form has a broad black fascia at the distal third and a large black sub-triangular or arrowhead-shaped macula on each side behind the transverse band.

Swezey (1945:335, under the name *servus*) has summarized the local information regarding the species and gives notes on its biology. I have seen the adults feeding on the ovaries of the Kuhio vine.

Tribe ORSILLINI (Stål) Van Duzee, 1916

Orsillaria Stål, 1872.
Nysiina Uhler, 1876.
For a detailed description of the group including an extended discussion, see Usinger, 1942:14.

This is the largest and apparently the most complexly developed tribe of bugs in Hawaii. It is the only major group of Hawaiian Heteroptera which has received adequate attention and may be assumed to be fairly well known. For our knowledge of the Hawaiian Orsillini, we are indebted to Usinger and his outstanding monograph of the Hawaiian members of the tribe (1942:1–167, figs. 1–9, pls. 1–12). In my opinion, Usinger's report is one of the finest pieces of work ever written

on any group of Hawaiian insects. It is so complete that I can add almost nothing new here. However, the last word has not been written on the Hawaiian complex, and much work awaits completion. I have abstracted freely from Usinger's paper and have used his keys, but I have modified and recast them to fit the style used in this manual, and I have found it necessary to alter some of the sections which appear to me to need strengthening. I believe use will reveal other necessary changes.

About one-half of the described species of the world's Orsillini occur in Hawaii. Some of them are beautiful insects, in spite of their mostly somber colors. The local group is complexly developed and is, therefore, a taxonomically difficult assemblage of forms. The status of some of the genera and certain of the species and lesser forms may be open to question, but these are problems that only more detailed investigations, and perhaps breeding experiments, can solve—if they can be solved by the methods available to us.

The Hawaiian Orsillini include some of the most common and most abundant of all Hawaiian insects. Species occur from near the seashore to the tops of the mountains. Some species are numerous on introduced plants in lowland areas where almost every other vestige of indigenous insect life has been exterminated or driven out.

Perkins (1913:cxcv) said that "The disgusting odour that they emit" renders them "unpleasant objects to collect." Some of us are not so disturbed by their "buggy" odor.

Some of our species, because of their lowland distribution and their breeding on foreign plants, have almost all the characteristics of non-endemic insects. This is another peculiarity of the group.

Because the tribe is much more highly developed and diversified than the early workers considered it to be, many of the records existing in literature prior to Usinger's monograph are erroneous and should be ignored unless checked with great care. For example, Kirkaldy considered at least one of our species to be the same as the Australian crop pest *Nysius vinitor* Bergroth and published notes on its biology under that name. Swezey (1942:200–202) has published a list of corrections to the confused local literature concerning the group.

The foreign *Nysius vinitor* Bergroth (the Rutherglen bug) of Australia and *Nysius ericae* (Schilling) (the false chinch bug) of Europe and North America are notorious crop pests. Certain other species of *Nysius* cause damage to various truck and orchard crops in various parts of the world. Sporadic damage by certain predominantly lowland species of *Nysius* is reported in Hawaii from time to time. The species involved are usually *Nysius nemorivagus* White, *N. coenosulus* Stål, *N. terrestris* Usinger and *N. nigriscutellatus* Usinger. These species often build up unusually high populations on various weeds (such as amaranth and *Portulaca*), and then, because of overcrowding, lack of ample food or the drying up or removal of their hostplants, swarms of the bugs may transfer their interests to certain truck crops or fruits and may on occasion cause some damage. Certain observers, however, are likely to become unduly alarmed over these habits in

Hawaii. Some of the species, I feel, have been accused unjustly of doing damage to various crops simply because they have been seen resting on the plants, or other bugs have been confused with them (see note under *Pachybrachius nigriceps*). It appears that a logical approach to preventive and control measures would here consist of adequate clean culture in the fields to reduce the available weed hosts early in the season and thus discourage the building up of large *Nysius* populations. It is merely asking for trouble to have one's truck gardens surrounded and invaded by masses of known *Nysius* weed hosts. Special attention should be given to clearing amaranth, *Portulaca* (pig weed) and *Erigeron* from the fields if *Nysius* do cause trouble.

I feel that the hostplant lists need careful checking, because the species are frequently captured while resting on a plant upon which they do not feed.

Among the insect parasites and predators of the Hawaiian Orsillini may be mentioned the scelionid wasp *Microphanurus vulcanus* (Perkins) (*Telenomus*), which has been reared from the eggs of a species of *Nysius;* the Nabidae, Reduviidae and Anthocoridae (which groups attack principally the nymphs); and the larrid wasp *Silaon rohweri* Bridwell, which provisions its nests with various orsillines. Spiders, toads, skinks, geckoes, certain birds and the voracious ant *Pheidole megacephala* (Fabricius) all exert pressure upon various Orsillini. Usinger's observations (1942:154) that "toads, skinks, and geckoes, although feeding extensively on invertebrates in the lowlands, have not been observed frequenting the particular places where *Nysius* occur" needs modification.

Usinger was able to make a number of observations on the nymphal stages of several species of various groups and his paper should be consulted for details. The following is his key to the nymphs of 10 species representing three of the five genera. The immature stages of *Nesomartis* and *Glyptonysius* have not been studied.

Key to the Nymphs of Some Hawaiian Orsillini

1. Head with at least two complete, anteriorly divergent, longitudinal, black or white fasciae sublaterally near eyes. Genus *Nysius* 2

   Head black or white-marked but with only a short, incomplete spot or stripe on either side along inner margin of epicranial arm near eyes and often with the inner stripes incomplete or wanting 3

2(1). Discs of head and thorax in great part fuscous with white spots; sides of pronotum and hemelytral pads laterally scarcely lamellately expanded, very narrowly pale .... **Nysius rubescens** White.

   Discs of head and thorax in great part longitudinally alternately striped with fuscous and white, the fuscous areas more or less spotted with white; sides of pronotum and hemelytral pads broadly, lamellately expanded and broadly pale ..... **Nysius coenosulus** Stål.

3(1). Epicranial arms scarcely sinuate near inner, posterior angles of eyes; head very long, broad and convex in

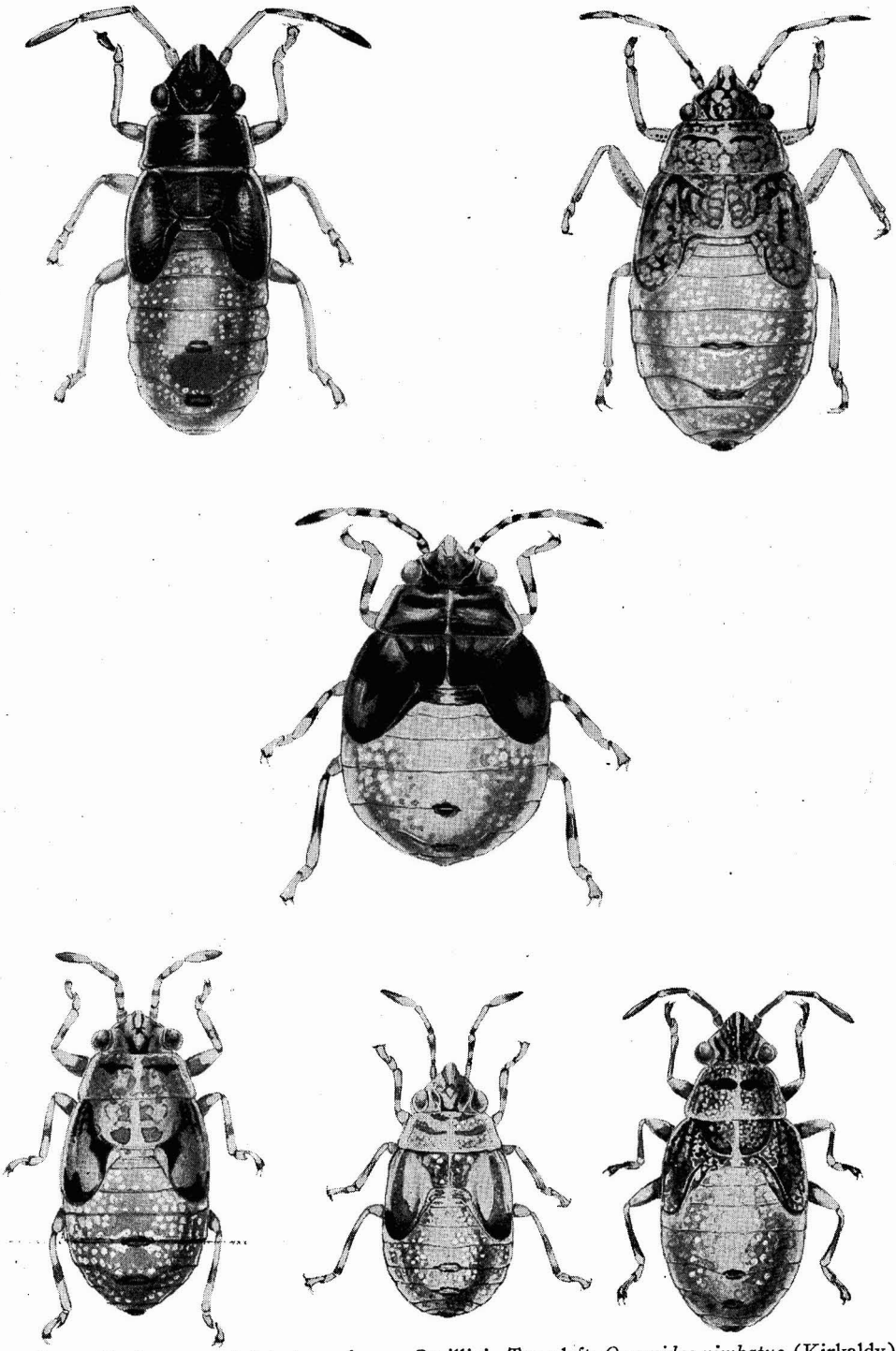

Figure 21—Last nymphal instars of some Orsillini. Top: left, *Oceanides nimbatus* (Kirkaldy); right, *Neseis* (*Icteronysius*) *ochriasis maculiceps* (Usinger). Middle: *Neseis* (*Physonysius*) *molokaiensis* Usinger. Bottom: left, *Neseis* (*Trachynysius*) *fasciatus fasciatus* Usinger; middle, *Neseis* (*Trachynysius*) *fulgidus* Usinger; right, *Nysius rubescens* White. (After Usinger.)

front of eyes; pronotum and hemelytral wing pads roundly convex, abruptly depressed and narrowly lamellate at sides. Genus *Oceanides*..... 4

Epicranial arms distinctly sinuate near inner posterior angles of eyes; head often subflattened above and always less convex anteriorly; pronotum and hemelytral wing pads much flatter, sides often strongly lamellately expanded. Genus *Neseis* 6

4(3). Head, pronotum and mesonotum, including hemelytral pads, entirely black except for narrow lamellate margins .....**Oceanides nubicola** (Kirkaldy).

Head and thorax above, light brown with darker markings.. 5

5(4). Color pale fulvous with darker brown on base of head, callosities, and hemelytral pads apically; size small, 3.27 mm. in length.....**Oceanides membranaceus** Usinger.

Color darker brown with pale spots on pronotum and mesonotum and dark brown to black callosities and hemelytral pads apically; size larger, 4.72 mm..... .....**Oceanides nimbatus** (Kirkaldy).

6(3). Head and thorax brown, entirely pale-spotted or streaked; head ivory-white with distinctive longitudinal brown markings; hemelytral pads neither lamellately expanded nor sublaterally impressed..... .....**Neseis (Icteronysius) ochriasis maculiceps** (Usinger).

Head and thorax otherwise, hemelytral pads clear and immaculate at middle, lateral margins either lamellately expanded or sublaterally impressed..... 7

7(6). Body very broad, particularly posteriorly, two-thirds as broad as long, hemelytral pads distinctly, sublaterally impressed....**Neseis (Physonysius) molokaiensis** Usinger.

Body more slender, about half as wide as long, hemelytral pads distinctly expanded. *Neseis* subgenus *Trachynysius*.. 8

8(7). Rostrum short, not reaching posterior coxae..... .....**Neseis (Trachynysius) fasciatus** Usinger.

Rostrum longer, exceeding posterior coxae..... 9

9(8). Body short, broad and subflattened above, only twice as long as broad, head only indistinctly marked with brown; size small, 2.77 mm..... .....**Neseis (Trachynysius) fulgidus** Usinger.

Body longer and more slender, over twice as long as broad, 77:33; color very pale, head with ivory-white markings; size larger, 4.27 mm..... .....**Neseis (Trachynysius) nitidus pipturi** Usinger.

I have made some changes in Usinger's key to the genera, which, I trust, will enable workers to use it with more facility than was previously possible. Some of the characters, as originally outlined, are rather obscure and misleading to one unfamiliar with the complexes of species involved. Moreover, certain of the characters originally used appear to me to be specifically variable and are apt to be variously interpreted by different readers. Such changes are to be expected in

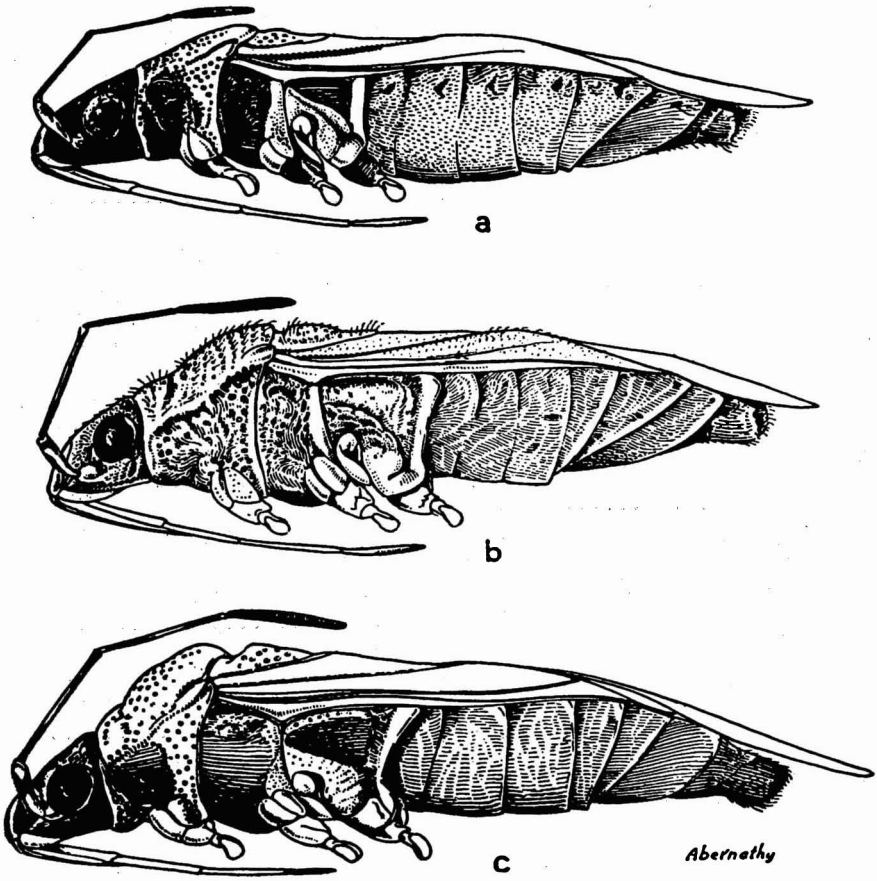

Figure 22—Side views of females of three genera of Orsillini to show some of the characters used in the following keys. **a,** *Oceanides nimbatus* (Kirkaldy); **b,** *Nysius delectus* White; **c,** *Neseis* (*Trachynysius*) *saundersianus* (Kirkaldy). (After Usinger, 1942.)

any complex work. Additional alterations and corrections will have to be made, for it is only by use that the keys can be perfected. Before using the generic and specific keys, the reader should thoroughly familiarize himself with the nature of the characters involved and make full use of all the illustrations. Most of these insects have good differential characters, but they must be examined with care if one is to identify his collections properly.

Key to the Genera of Hawaiian Orsillini

1. Body in great part clothed with subappressed, pale pubescence, distinct on clavus and corium and often with longer, erect hairs as well (fig. 22, b); claval sutures and vein R+M usually without conspicuous rows of punctures except sometimes basad (these punctures distinct in *Nysius sublittoralis* and less distinct in *Nysius*

fucatus) ; posterior margin of metapleuron concave, its outer angle moderately produced and rounded (fig. 22, b) ; elevated parts of bucculae reaching about midway between level of apices of antenniferous tubercles and base of head (fig. 22, b) 2

Body almost naked above (fig. 22, a, c), or at least without a subappressed pubescence on clavus and corium (except in *Oceanides pteridicola,* in which the postero-lateral angle of metapleuron is a right angle) ; claval sutures and vein R+M with distinct rows of punctures. Postero-lateral angle of metapleuron usually either sharply right-angled (fig. 22, a) or subangulately produced (fig. 22,c) ; elevated parts of bucculae scarcely surpassing level of antenniferous tubercles (fig. 22, a, c) 3

2(1). Head, including eyes, broader than greatest width of pronotum ..... **Nesomartis** Kirkaldy.

Head, including eyes, always narrower than greatest width of pronotum ..... **Nysius** Dallas.

3(1). Upper surface of head relatively strongly elevated along middle, as viewed from side, with conspicuous, sinuous wrinkles; posterior margin of metapleuron rectilinear, its posterior angle a right angle ..... **Oceanides** (Kirkaldy).

Head variously formed but never with above combination; posterior margin of metapleuron always more or less concave, postero-lateral angle either moderately produced and subrounded or strongly produced and subacute 4

4(3). Antenniferous tubercles angular laterally and sub-carinate, the "carinae" extending back to inner anterior margins of eyes (best seen from above), the distance between fore edge of eye and apex of tubercle about three-fourths or more than three-fourths as long as first antennal segment; pronotal and hemelytral discs with brown to black, laevigate elevations as in figures of *Glyptonysius* (fig. 27), but do not confuse with the usual smooth anterior callosities on *Neseis* ..... **Glyptonysius** Usinger.

Antenniferous tubercles not laterally carinate, much shorter, usually less than one-half as long as antennal segment one; pronotal and hemelytral discs without irregular laevigate elevations, except for usual pronotal callosities ..... **Neseis** (Kirkaldy).

Genus **OCEANIDES** (Kirkaldy, 1910:536) Evans, 1929:353

This endemic genus was redescribed by Usinger (1942:17–18). It shares with *Neseis* and *Glyptonysius* the mostly naked dorsum (excepting *Oceanides pteridicola*), but most of the species have the head more convex (so that when viewed from the side the median line rises distinctly above the level of the tops of the eyes), distinctly more coarsely sculptured, and the hind margin of the metapleuron is nearly straight, not distinctly concave, and its postero-lateral angle is a right angle or nearly so.

Although Usinger recognized 23 forms in this genus, he considered them all full species and named no subspecies nor varieties. Thus, this genus contains more *full species* than any of the other groups, although the *Neseis* complex has 20 species with 14 subspecific and varietal forms. *Nysius,* itself, has 22 species and two lesser forms.

Two keys to the species are given below. The first of these is recast from Usinger; the other is a set of new tables primarily based upon geographical distribution.

Key Section I

General Key to the Species of Oceanides

1. Clavus and corium clothed with very short, appressed, pale hairs; Maui and Hawaii..... **pteridicola** (White).
   Clavus and corium naked, or with scattered, almost invisible, short, erect bristles..... 2

2(1). Clavus and corium distinctly but irregularly marked with dark brown to ferrugineous spots or blotches, some of which anastomose, the maculations of the two sides usually asymmetrical 3
   Clavus and corium more or less maculated but always regularly and symmetrically..... 4

3(2). Costal margins of coria evenly arcuate throughout; Oahu, Molokai, Lanai, Maui..... **montivagus** (Kirkaldy).
   Costal margins of coria strongly dilated but subparallel at middle, being widest anteriorly in male and posteriorly in female; Hawaii..... **vulcan** (White).

4(2). Entire body, or at least parts of pronotum, with distinct reddish or reddish-ferrugineous tinge..... 5
   Body ochraceous or paler with brown or black markings.... 9

5(4). Rostrum not surpassing posterior coxae; membrane rather uniformly embrowned, with veins sometimes faintly paler; Oahu ..... **delicatus** Usinger.
   Rostrum slightly to distinctly surpassing posterior coxae, reaching second abdominal segment at least; membrane variously maculated but never evenly embrowned throughout 6

6(5). Rostrum reaching only onto second abdominal segment, first segment not or scarcely reaching base of head; membrane generally infuscated with veins clear, thus forming, when crossed at rest, an oblique cross-hatching of pale lines 7
   Rostrum reaching third abdominal segment at least, first segment slightly surpassing base of head; membrane pale basally and on either side near apices of coria..... 8

7(6). Anteocular portion of head distinctly longer than an eye; pronotum rather sparsely punctate, irregular rows of punctures on posterior lobe more than one puncture width apart; size large, 4.4 to 5 mm.; Hawaii.....
   ..... **nubicola** (Kirkaldy).

Anteocular portion of head subequal to, or a little shorter than, length of an eye; pronotum densely punctate, irregular rows of punctures on posterior lobe less than one puncture width apart; size usually smaller, 3.94 to 4.5 mm.; Kauai ..... **myopori** Usinger.

8(6). Membrane very distinctly marked with brown, broadly from middle of apical margins of coria on either side, then more narrowed to center and thence widening, fan-like, to apex; elsewhere clear, white; size small, 4.11 to 4.55 mm.; Oahu..... **picturatus** Usinger.

Membrane indistinctly pale basally and laterally; size larger, 4.86 to 5.13 mm.; Kauai..... **ventralis** Usinger.

9(4). Rostrum not or scarcely exceeding posterior coxae.....10

Rostrum reaching middle of second abdominal segment or beyond 14

10(9). Pronotum relatively densely punctate, punctures coarse and much less than one puncture width apart except posteriorly; with four or five rows of closely approximated punctures in front of callosities; clavus and corium uniformly brown in color with a darker brown spot at middle of apical margin of corium; membrane uniformly, palely infuscated; large and strongly dilated posteriorly, 5.7 to 6.2 mm. by 2.3 to 2.5 mm.; Maui..... **dilatipennis** Usinger.

Pronotum less densely and usually more finely punctate, with not more than three rows of punctures in front of callosities; hemelytra never as above; size usually much smaller and never exceeding 5.16 by 2.2 mm.....11

11(10). Pronotum comparatively long and narrow (fig. 23, *bimaculatus,* and fig. 26, *sinuatus*), more than 60 percent as long as broad, posterior lobe pale, or at most with humeral angles darker; clavus immaculate and corium with black marks narrowly confined to apical margin and only broadening out to costal margin subapically in one species 12

Pronotum shorter and broader, less than 60 percent as long as broad, posterior lobe varying in color but usually with broad, sublateral fuscous areas extending to posterior margin; clavus infuscated at least apically; corium sometimes infuscated basally and always broadly fusco-maculate on apical fourth except laterally and subapically.....13

12(11). Head densely clothed with long, appressed, pale hairs; corium distinctly marked with brown along apical margin and sometimes dark at inner and outer ends of apical margin; pronotal disc with numerous fine punctures; lateral margins scarcely sinuate; Maui..... **bimaculatus** Usinger.

Head only sparsely clothed with a short, appressed, pale pubescence; corium slightly embrowned along entire apical margin, with a small spot at middle of apical margin; pronotal disc with only a few coarse punctures; sides distinctly sinuate; Oahu..... **sinuatus** Usinger.

13(11).. Head above very strongly, irregularly rugose; clavus and

corium broadly fusco-maculate both basad and along at least inner half of apical margin; Oahu...**perkinsi** Usinger.
Head less strongly rugose and often smooth or slightly transversely wrinkled at middle; clavus and corium immaculate basad; Oahu.....**arboricola** (White).

14(9). Clavus and corium entirely pale and immaculate or, at most, with a spot or U-shaped mark at apex of cell R+M 15
Clavus often infuscated apically and corium always with more extensive markings along apical margin, including a broad fuscous spot apically between vein Cu and claval suture 16

15(14). Anteocular part of head shorter than an eye; pronotal disc subflattened; size small, 4.22 to 4.66 mm. long; Kauai .....**planicollis** Usinger.
Anteocular part of head longer or occasionally (Lanai specimens) subequal to length of eyes; pronotal disc moderately convex; size larger, 4.66 to 6.11 mm.; all the islands except (?) Molokai.....**nimbatus** (Kirkaldy).

16(14). Color often very dark, the dark-brown to black areas exceeding in extent the pale areas and at least with large black marks at middle of basal third of corium as well as broadly along apical margin; pronotum usually entirely black except for pale humeri and a pale spot at middle of posterior margin.....17
Black markings of hemelytra always less extensive.....18

17(16). Body form broadly oval; pronotum impunctate and transversely rugose posteriorly; membrane black, even at base; Maui .....**oresitrophus** (Kirkaldy).
Body form elongate-oval, slender; pronotum at least sparsely punctate and transversely rugose posteriorly; membrane pale at base and with pale veins; Oahu..... .....**oribasus** (Kirkaldy).

18(16). Membrane with a dark-brown mark from middle of apical margin of corium on either side, extending apically, crossing at middle, and when hemelytra are folded at rest, appearing narrowly expanded, fanlike, posteriorly; Oahu .....**membranaceus** Usinger.
Membrane variously variegated or infuscated but never as above 19

19(18). Rostrum very long, reaching well onto, or exceeding, third abdominal segment; Oahu .....**incognitus** Usinger.
Rostrum not exceeding second abdominal segment.....20

20(19). Posterior lobe of pronotum rather extensively embrowned, at least sublaterally; subapical corial spots practically reaching costal margins; membrane generally infuscated, without conspicuously clear veins; Kauai..... ..... **rugosiceps** Usinger.
Posterior lobe of pronotum immaculate or with brown confined to humeri; subapical corial spots not approximating costal margins; membrane variably infuscated but with veins, at least, clear.....21

21(20). Clavus infuscated apically; upper surface of head and margins of callosities with very inconspicuous, pale, appressed hairs; Hawaii ..... **bryani** Usinger.
Clavus immaculate apically; upper surface of head and margins of callosities with a distinct, conspicuous, golden, appressed pubescence 22
22(21). Humeral angles immaculate; callosities black; pronotum relatively long and broad; Lanai..... **fosbergi** Usinger.
Humeral angles brown; callosities pale brown to ferrugineous; pronotum short and narrowed; Oahu..... ..... **parvulus** Usinger.

It is worth while, I believe, to present here an additional key, based primarily upon geographical distribution, to facilitate identification of the 23 described forms of *Oceanides*. Only three members of the genus have been found on more than one island. *O. pteridicola* has been collected on Maui and Hawaii, *O. montivagus* on Oahu, Molokai, Lanai and Maui, and *O. nimbatus* has been taken on Kauai, Oahu, Lanai, Maui and Hawaii. Inasmuch as there has been only one species found on Molokai (*montivagus*), that island is not included in the following tabulation. It should be kept in mind that keys based primarily upon geographical segregation will work only so long as the known distribution remains as at present. We may with good reason expect that *O. nimbatus,* which occurs on all of the main islands excepting Molokai, will be found on that island when more extensive collecting is done, and, also, that other species of *Oceanides* inhabit Molokai but have not yet been discovered. The main key should be used to check identifications where necessary.

Key Section II

Island Keys for the Separation of the Species of Oceanides

section a—key to the kauai oceanides

1. Entire body, or at least parts of pronotum, with a distinct reddish or reddish-ferrugineous tinge..... 2
Body ochraceous or paler with brown or black markings.... 3
2(1). Rostrum reaching only onto second abdominal sternite, its first segment not or scarcely reaching base of head; wing membrane generally infuscated with veins clear, thus forming, when crossed at rest, an oblique cross-hatching of pale lines..... **myopori** Usinger.
Rostrum reaching third abdominal sternite at least, its first segment extending slightly behind base of head; membrane pale basad and on either side near apices of coria ..... **ventralis** Usinger.
3(1). Rostrum extending only to about middle of ventrite two.. ..... **planicollis** Usinger.
Rostrum extending onto third ventrite..... 4
4(3). Corium with a brown mark at apex of cell R+M, wing otherwise almost immaculate, pale....**nimbatus** (Kirkaldy).
Corium with at least two large maculations, one near apex of claval suture and one which may extend from cell R+M nearly to wing margin.....**rugosiceps** Usinger.

SECTION B—KEY TO THE OAHU OCEANIDES

1. Clavus and corium irregularly marked with numerous dark spots and blotches, some of which anastomose..... .....**montivagus** (Kirkaldy).
Clavus and corium with comparatively regular and symmetrical maculations 2

2(1). Rostrum not or hardly reaching behind metacoxae..... 3
Rostrum extending to or beyond middle of second abdominal segment 6

3(2). Pronotum more than 60 percent as long as broad..... 4
Pronotum less than 60 percent as long as broad..... 5

4(3). Pronotal callosities reddish-brown; lateral arcuation of corium beginning distinctly behind base...**delicatus** Usinger.
Pronotal callosities shiny black; lateral arcuation evidently continuous from base .....**sinuatus** Usinger.

5(3). Clavus and corium with a large, conspicuous, common, dark humeral blotch; rostrum not extending behind metacoxae, first segment reaching base of head.....**perkinsi** Usinger.
Clavus and corium without such humeral maculation; rostrum extending behind metacoxae, its first segment distinctly not reaching base of head.....**arboricola** (White).

6(2). Clavus and corium almost entirely pale, with only a U-shaped mark at apex of cell R+M....**nimbatus** (Kirkaldy).
Clavus and corium largely dark or with more extensive maculations..... 7

7(6). Very dark species, almost entirely dark brown or black, dark areas usually much more extensive than pale maculations .....**oribasus** (Kirkaldy).
Much paler species, pale areas more extensive than dark maculations 8

8(7). Membrane (hemelytra closed at rest) with an oblique vitta running from each corium to middle line, thence expanding down middle to apex, this mark often appearing Y-shaped; at least with a distinct median vitta..... 9
Membrane spotted, but never with such a pattern as indicated above 10

9(8). Sides of body with a reddish tinge; clavi dark distad; rostrum reaching third abdominal segment..**picturatus** Usinger.
Sides of body not tinged with red; clavi immaculate; rostrum reaching middle of second ventrite..... .....**membranaceus** Usinger.

10(8). Rostrum reaching beyond middle of third abdominal segment .....**incognitus** Usinger.
Rostrum reaching middle of second ventrite..... .....**parvulus** Usinger.

SECTION C—KEY TO THE LANAI OCEANIDES

1. Rostrum reaching third abdominal sternite..... .....**nimbatus** (Kirkaldy).
Rostrum not extending behind middle of second ventrite... 2

2. Clavus and corium irregularly and conspicuously maculate throughout ..... **montivagus** (Kirkaldy).
Clavus immaculate or nearly so, corium maculate only near membrane ..... **fosbergi** Usinger.

SECTION D—KEY TO THE MAUI OCEANIDES

1. Dorsum, except membrane, clothed with conspicuous, appressed, pale hairs ..... **pteridicola** (White).
Dorsum, at least clavus and corium, naked, or with scattered, almost invisible, short, erect setae 2

2(1). Rostrum not or hardly passing posterior edges of metacoxae .. 3
Rostrum reaching or passing middle of second abdominal ventrite 4

3(2). Pale-yellowish species; coria with only about two or three dark maculae and these caudad; lateral margins of pronotum hardly sinuous, nearly straight ..... **bimaculatus** Usinger.
Dark-brown to black species, hemelytra almost entirely dark; lateral margins of pronotum conspicuously, strongly sinuous ..... **dilatipennis** Usinger.

4(2). Rostrum extending onto third abdominal ventrite; pale species with hemelytra with only a conspicuous dark spot near apex of vein R ..... **nimbatus** (Kirkaldy).
Rostrum not reaching third ventrite; hemelytra with more numerous maculations 5

5(4). Posterior part of pronotum distinctly punctate and without a trace of transverse wrinkles; clavi and coria with numerous, small, irregular, anastomosing maculae forming an almost subreticulate pattern .. **montivagus** (Kirkaldy).
Posterior part of pronotum nearly impunctate and with three or four conspicuous, transverse wrinkles; clavi nearly immaculate, coria with several comparatively large and regular maculae (about four on each corium) ..... **oresitrophus** (Kirkaldy).

SECTION E—KEY TO THE HAWAII OCEANIDES

1. Dorsum, except membrane, clothed with conspicuous, appressed, pale hairs ..... **pteridicola** (White).
Hemelytra, at least, naked or nearly so, at most with scattered, almost invisible, short, erect setae 2

2(1). Rostrum extending onto third abdominal ventrite; corium with a single dark macula near apex of vein R ..... **nimbatus** (Kirkaldy).
Rostrum not passing second ventrite; corial maculae more numerous 3

3(2). Head with a distinct median vitta (usually reddish; rarely obscure), the insect usually with a rather conspicuous reddish cast ..... **nubicola** (Kirkaldy).
Head, excepting tylus, entirely black above, not vittate; not reddish-tinged 4

4(3). Clavi and coria irregularly, confusedly maculate; sides of pronotum almost straight ..... **vulcan** (White).
Clavi at most infuscated caudad; maculae of coria distinct, symmetrical, lying adjacent to membrane, usually three in number, one at base, one near middle and a smaller apical spot; sides of pronotum distinctly sinuous ..... **bryani** Usinger.

Oceanides arboricola (White) (fig. 23).
Nysius arboricola White, 1878:368.
Oceanides arboricola (White) Usinger, 1942:41, pls. 2, 6.

Endemic. Oahu (type locality: none designated by White, but probably Mount Tantalus or vicinity).
Perkins (1912:732) said that this species was found abundantly "usually frequenting the branches of trees, living or dead." He also considered *nimbatus* to be a variant and a synonym.

Oceanides bimaculatus Usinger (fig. 23).
Oceanides bimaculatus Usinger, 1942:37, pl. 3, B.

Endemic. Maui (type locality: Haelaau).
Hostplant: *Alyxia.*

Oceanides bryani Usinger (fig. 23).
Oceanides bryani Usinger, 1942:28, nymph 147, pl. 2, A.

Endemic. Hawaii (type locality: Humuula).
Hostplants: *Euphorbia, Straussia hawaiiensis.*
A single egg obtained by Usinger hatched 19 days after oviposition. He describes the first nymphal instar.

Oceanides delicatus Usinger (fig. 23).
Oceanides delicatus Usinger, 1942:25, pl. 3, H.

Endemic. Oahu (type locality: Pukuloa Valley).
Hostplant: *Elaeocarpus.*

Oceanides dilatipennis Usinger (fig. 23).
Oceanides dilatipennis Usinger, 1942:43, pl. 2, B.

Endemic. Maui (type locality: Mahana).

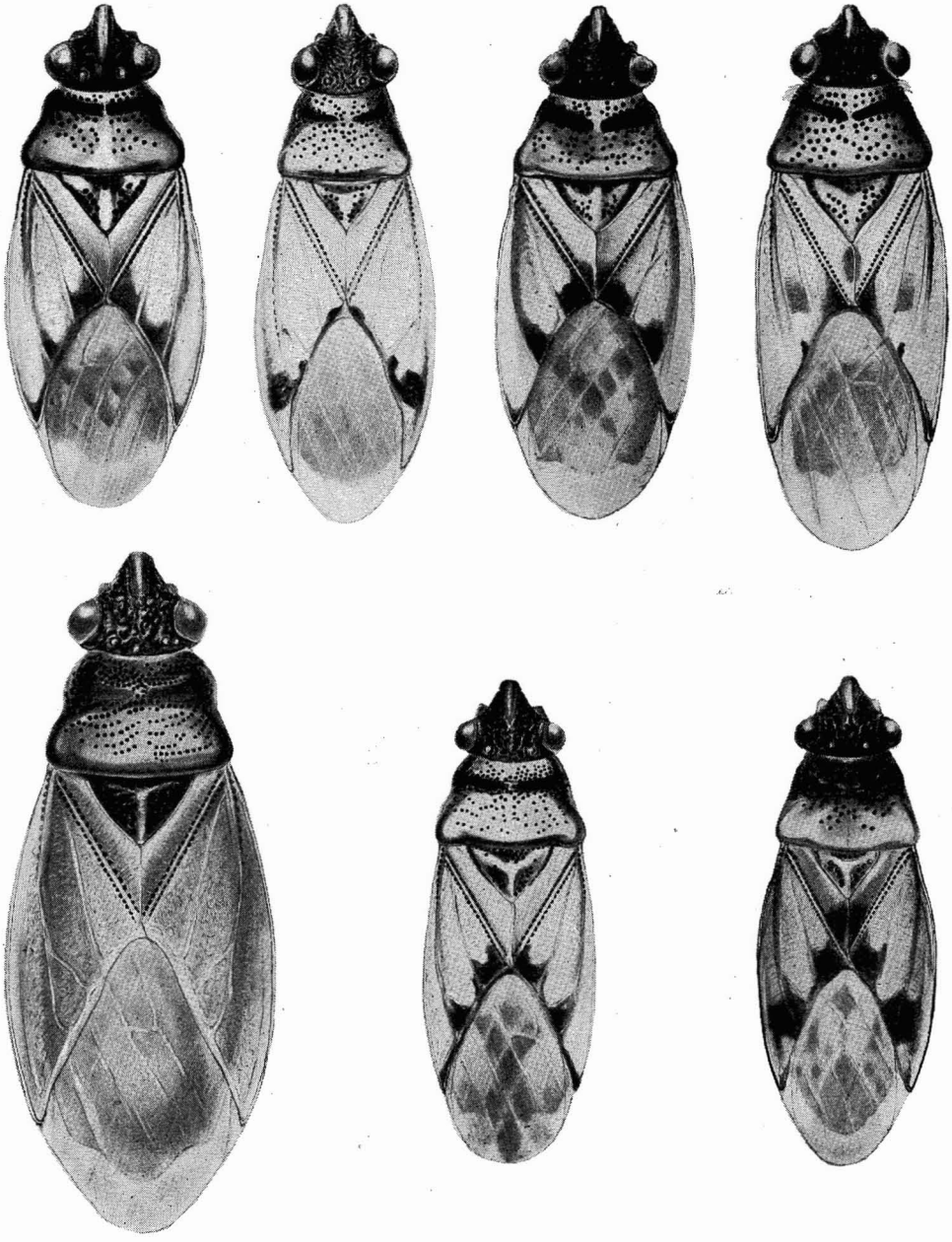

Figure 23—Some species of *Oceanides*. Top row, left to right: *O. arboricola* (White), female; *O. bimaculatus* Usinger, paratype male; *O. bryani* Usinger, paratype female; *O. delicatus* Usinger, female. Bottom row, left to right: *O. dilatipennis* Usinger, paratype female; *O. fosbergi* Usinger, paratype female; *O. incognitus* Usinger, holotype male. (Rearranged from Usinger's original Abernathy drawings.)

Oceanides fosbergi Usinger (fig. 23).
Oceanides fosbergi Usinger, 1942:31, 147 nymph; pl. 3, A.

Endemic. Lanai (type locality: Lanaihale).
Hostplants: *Coprosma, Scaevola, Straussia.*
Usinger found that the incubation period of two eggs collected was about 16 days. He described the first instar nymph.

Oceanides incognitus Usinger (fig. 23).
Oceanides incognitus Usinger, 1942:35, pl. 3, E.

Endemic. Oahu (type locality: Haleauau Valley).
Hostplants: *Myrsine, Pteralyxia.*

Oceanides membranaceus Usinger (fig. 24).
Oceanides membranaceus Usinger, 1942:34, 147, nymph; pl. 3, F.

Endemic. Oahu (type locality: Pukuloa Valley).
Hostplant: *Euphorbia.*
The last nymphal instar is described by Usinger.

Oceanides montivagus (Kirkaldy) (fig. 24).
Nysius montivagus Kirkaldy, 1910:544.
Oceanides montivagus (Kirkaldy) Usinger, 1942:21, pl. 1, C.

Endemic. Oahu, Molokai, Lanai (type locality, Perkins, 1912:734), Maui.
Hostplants: *Dodonaea, Dubautia, Metrosideros* (preferred host), *Pipturus, Sadleria.*

Oceanides myopori Usinger (fig. 24).
Oceanides myopori Usinger, 1942:26, pl. 1, F.

Endemic. Kauai (type locality: Kumuweia).
Hostplant: *Myoporum.*

Oceanides nimbatus (Kirkaldy) (figs. 21; 22, a; 24).
Nysius (Oceanides) nimbatus Kirkaldy, 1910:543. Perkins, 1912:732.
Oceanides nimbatus (Kirkaldy) Usinger, 1942:32, 148, nymph; pl. 3, G; pl. 12, A, nymph. Genotype.

Endemic. Kauai, Oahu (type locality: "Honolulu Mountains," 2,500–3,000 feet), Lanai, Maui, Hawaii.
Hostplants: *Coprosma, Broussaisia, Gouldia.*
The fifth instar nymph was described and illustrated by Usinger.

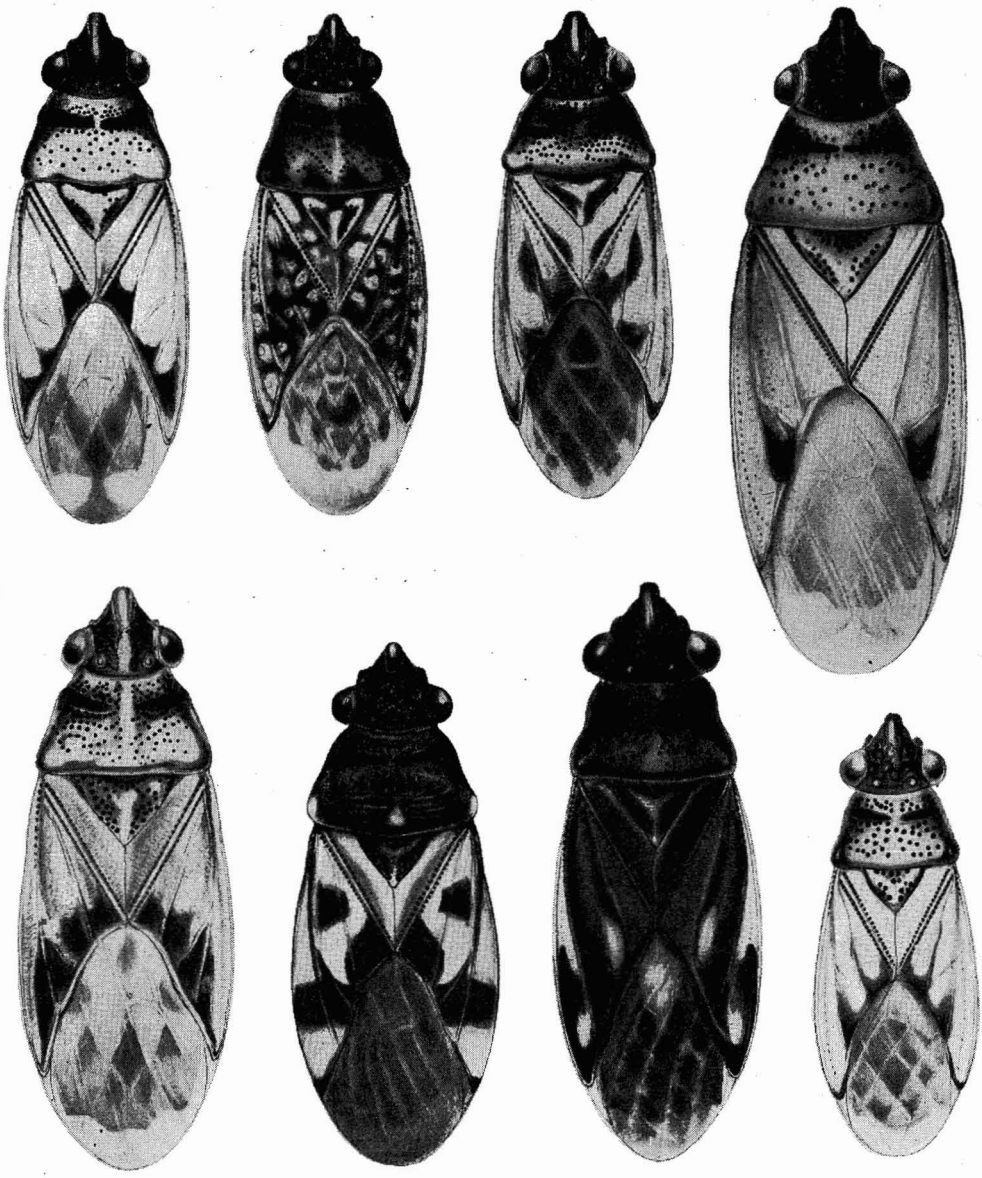

Figure 24—Species of *Oceanides*. Top row, left to right: *O. membranaceus* Usinger, female; *O. montivagus* (Kirkaldy), male; *O. myopori* Usinger, female; *O. nimbatus* (Kirkaldy), female. Bottom row, left to right: *O. nubicola* (Kirkaldy), female; *O. oresitrophus* (Kirkaldy), male; *O. oribasus* (Kirkaldy), female; *O. parvulus* Usinger, allotype female. (Rearranged from Usinger's original Abernathy drawings.)

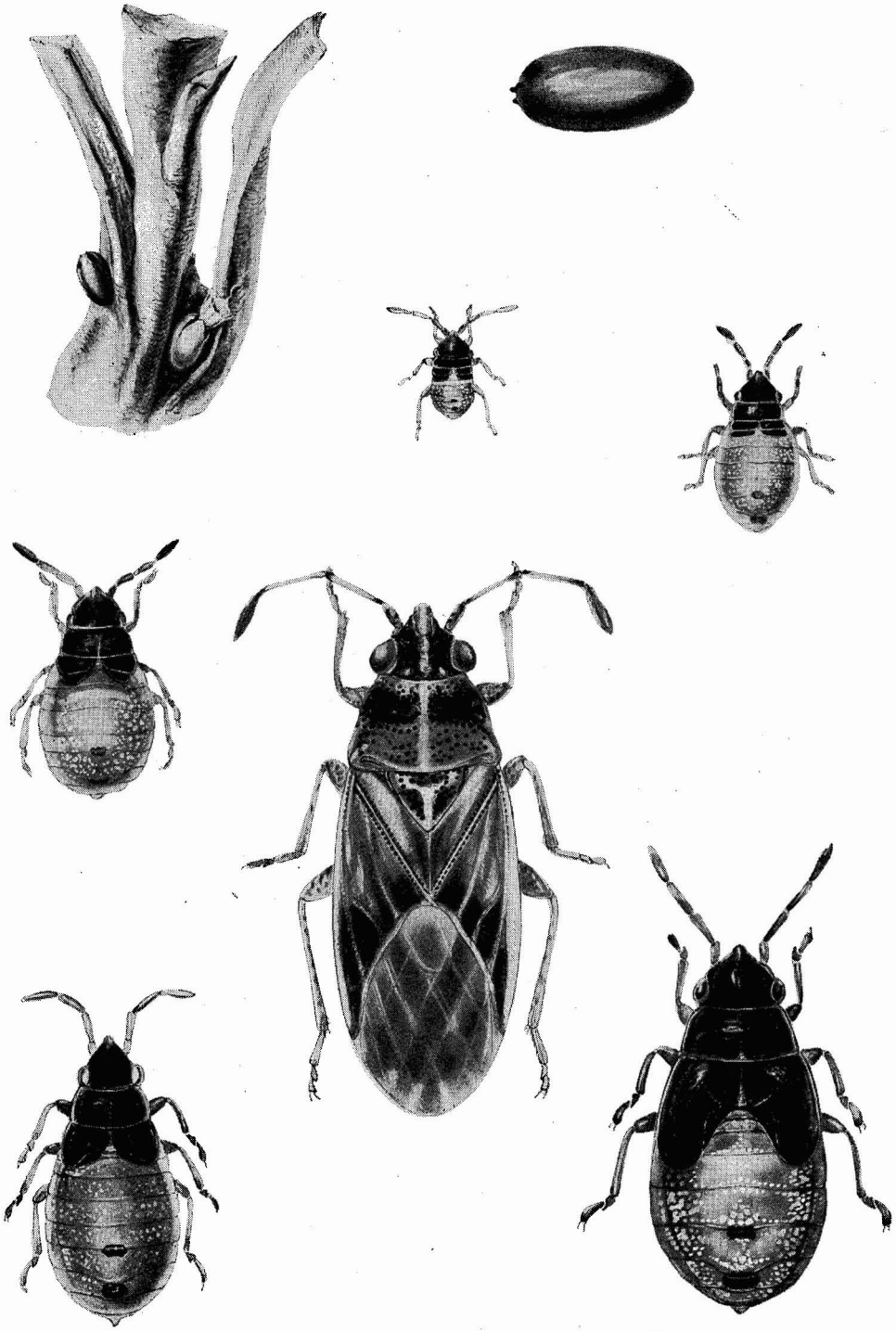

Figure 25—*Oceanides nubicola* (Kirkaldy): eggs in place on a stem of *Myoporum sandwicense*, egg (enlarged), five nymphal instars and an adult female. (After Usinger.)

Oceanides nubicola (Kirkaldy) (figs. 24, 25).
Nysius nubicola Kirkaldy, 1910:542.
Oceanides nubicola (Kirkaldy) Usinger, 1942:27, pl. 1, G.
Usinger, 1942:145–147, pl. 11 (life history), bionomics, detailed description of early stages.

Endemic. Hawaii (type locality: Kona).
Hostplant: *Myoporum sandwicense.*
Usinger gives detailed descriptions of all five nymphal instars, and he says (p. 147), "In general, the black head and thorax and ferrugineous abdomen with the transverse band of white covering basal abdominal segment will readily distinguish nymphs of this species from any other with which I am familiar." The eggs, which he found hatched in 19 or 20 days at 6,000 feet at Humuula, Hawaii, are described as follows (pp. 145–146):

Shape elongate-elliptical, broadest slightly before middle and thence gradually rounded in both directions to apices. Color rather uniform piceoferrugineous, the surface highly polished. Micropylar end with three or four white tubercles arranged as a square, rhombus, or triangle, the more closely approximated pair (where four are present) often located on the edge of a smooth, domelike elevation. In mature eggs dark eye spots may be seen just posterior to each of the lower tubercles. These, though obscure due to the dark color of the chorion, are still visible. Size: length 0.934 mm.; diameter 0.448 mm.

As in other Orsillini, hatching is accomplished by a splitting at the micropylar end so that a three-quarter circular flap acts as a lid. An embryonic membrane is then cast when the embryo quits the chorion.

Oceanides oresitrophus (Kirkaldy) (fig. 24).
Nysius oresitrophus Kirkaldy, 1910:542. Perkins, 1912:734.
Oceanides oresitrophus (Kirkaldy) Usinger, 1942:40, pl. 2, F.

Endemic. Maui (type locality: Haleakala, over 5,000 feet).

Oceanides oribasus (Kirkaldy) (fig. 24).
Nysius oribasus Kirkaldy, 1910:544. Perkins, 1912:734.
Oceanides oribasus (Kirkaldy) Usinger, 1942:38, pl. 2, G.

Endemic. Oahu (type locality: Waialua, 2,000 feet).
Hostplants: *Elaeocarpus, Straussia.*

Oceanides parvulus Usinger (fig. 24).
Oceanides parvulus Usinger, 1942:30, pl. 3, C.

Endemic. Oahu (type locality: Manoa–Palolo Ridge).
Hostplants: *Euphorbia, Straussia kaduana.*

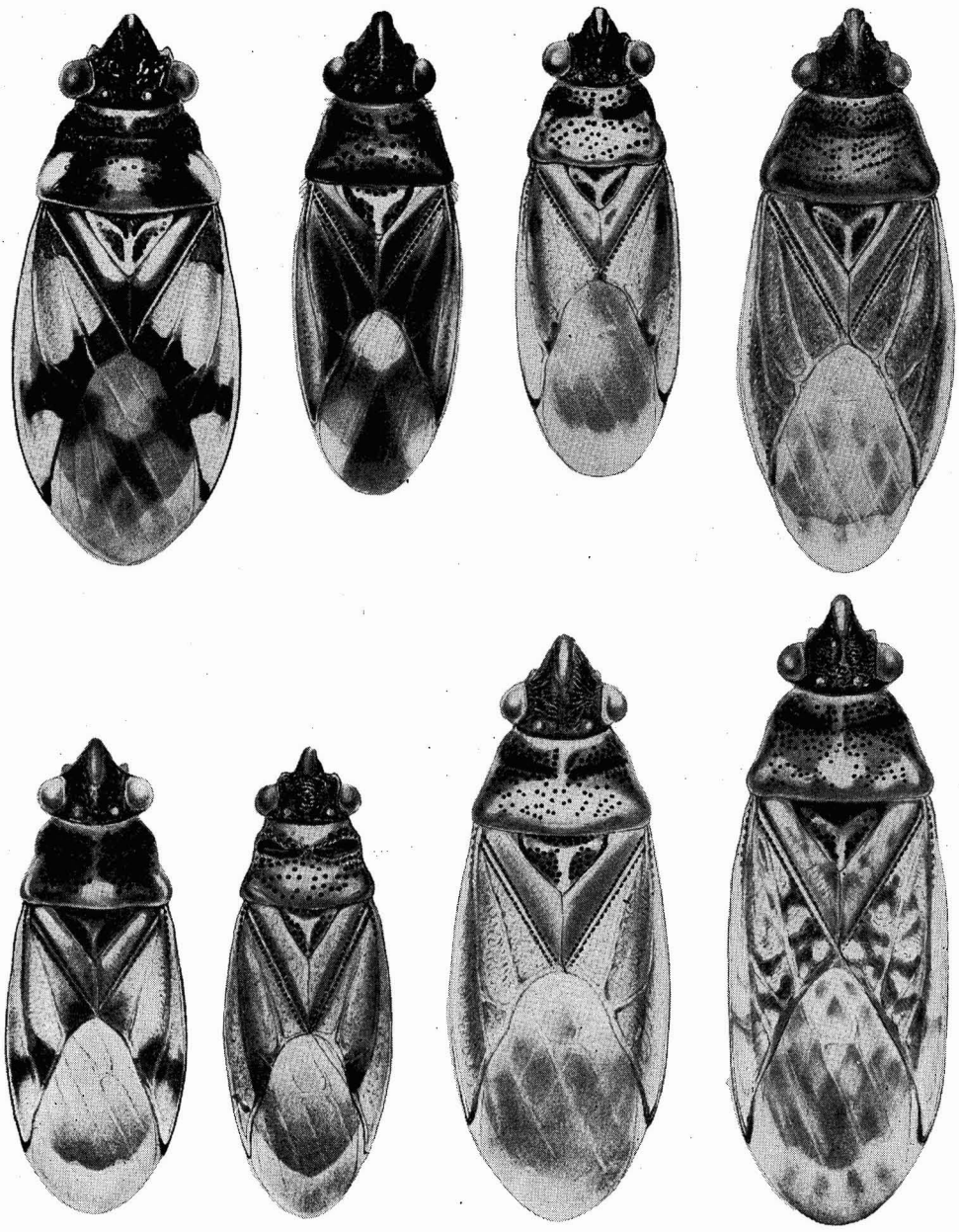

Figure 26—Some species of *Oceanides*. Top row, left to right: *O. perkinsi* Usinger, holotype female; *O. picturatus* Usinger, holotype male; *O. planicollis* Usinger, holotype male; *O. pteridicola* (White), female. Bottom row, left to right: *O. rugosiceps* Usinger, holotype male; *O. sinuatus* Usinger, holotype male; *O. ventralis* Usinger, holotype male; *O. vulcan* (White), female. (Rearranged from Usinger's original Abernathy drawings.)

Oceanides perkinsi Usinger (fig. 26).
Oceanides perkinsi Usinger, 1942:42, pl. 2, H.

Endemic. Oahu (type locality: Manoa–Palolo Ridge, 2,000 feet).

Oceanides picturatus Usinger (fig. 26).
Oceanides picturatus Usinger, 1942:24, pl. 1, E.

Endemic. Oahu (type locality: Kaumuahona).
Hostplant: *Wikstroemia.*

Oceanides planicollis Usinger (fig. 26).
Oceanides planicollis Usinger, 1942:28, pl. 3, D.

Endemic. Kauai (type locality: Halemanu).
Hostplant: *Euphorbia.*

Oceanides pteridicola (White) (fig. 26).
Nysius pteridicola White, 1881:55.
Nysius insulivagus Kirkaldy, 1910:544. Synonymy by Perkins, 1912:734.
Oceanides pteridicola (White) Usinger, 1942:20, pl. 1, A.

Endemic. Maui, Hawaii (type locality: near Kilauea, 4,000 feet).
Hostplant: *Metrosideros.*

Oceanides rugosiceps Usinger (fig. 26).
Oceanides rugosiceps Usinger, 1942:37, pl. 2, E.

Endemic. Kauai (type locality: Halemanu).
Hostplant: *Pterotropia.*

Oceanides sinuatus Usinger (fig. 26).
Oceanides sinuatus Usinger, 1942:36, pl. 2, D.

Endemic. Oahu (type locality: Puu Kaua).
Hostplants: *Artemisia, Styphelia.*

Oceanides ventralis Usinger (fig. 26).
Oceanides ventralis Usinger, 1942:24, pl. 1, D.

Endemic. Kauai (type locality: Kauaikinana).
Hostplant: *Wikstroemia.*

Oceanides vulcan (White) (fig. 26).
Nysius vulcan White, 1881:56. Perkins, 1912:734.
Nysius montivagus Kirkaldy, 1910:544, in part.
Oceanides vulcan (White) Usinger, 1942:23, pl. 1, B.

Endemic. Hawaii (type locality: Mauna Loa).
Hostplant: *Metrosideros.*

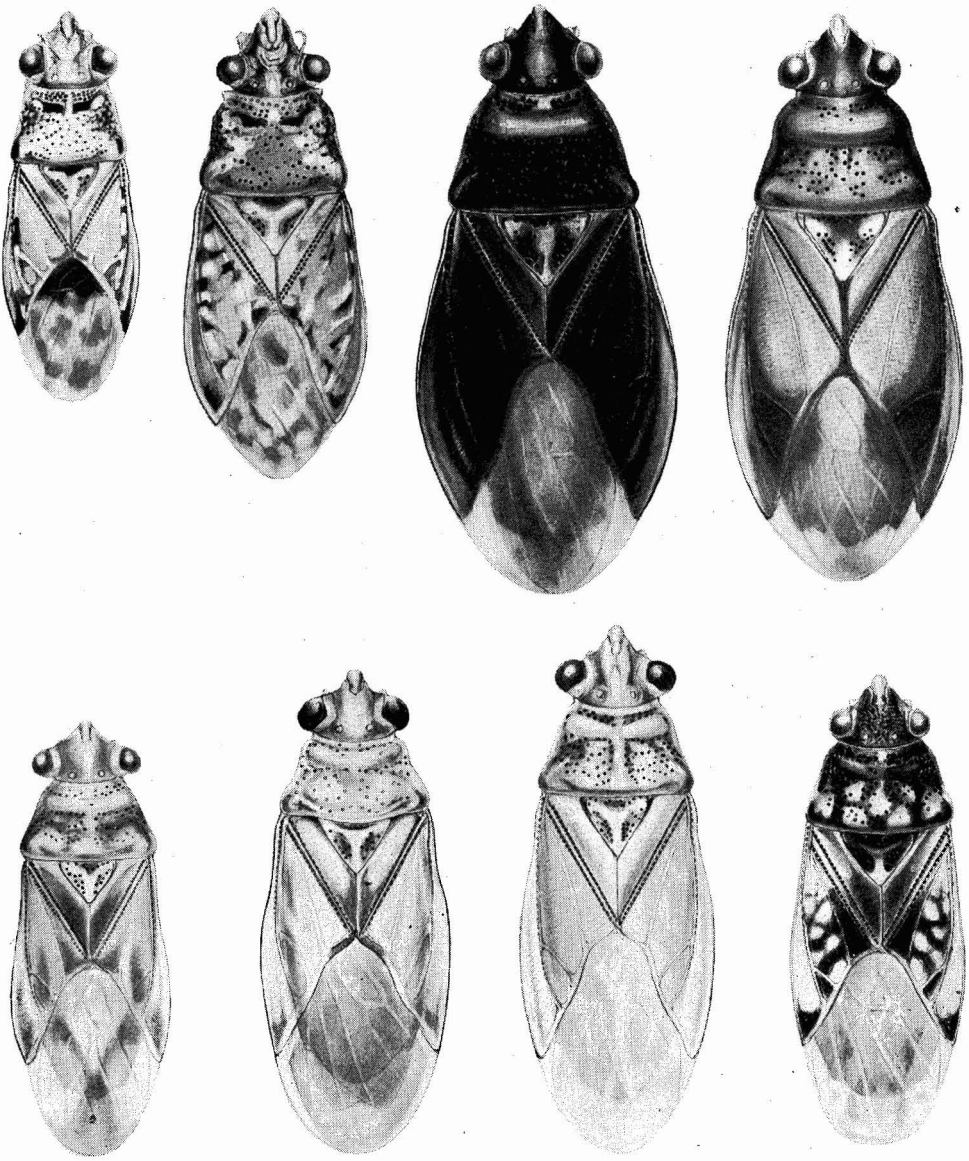

Figure 27—Some Orsillini. Top row, left to right: *Glyptonysius hylaeus* (Kirkaldy), male; *Glyptonysius laevigatus* Usinger, holotype male; *Neseis* (*Physonysius*) *ampliatus* Usinger, paratype female; *Neseis* (*Physonysius*) *molokaiensis* Usinger, paratype male. Bottom row, left to right: *Neseis* (*Leionysius*) *haleakalae* (Perkins), male; *Neseis* (*Leionysius*) *pallidus* Usinger, holotype male; *Neseis* (*Neseis*) *kirkaldyi* (Usinger), male; *Neseis* (*Trachynysius*) *alternatus* Usinger, holotype female. (Rearranged from Usinger's original Abernathy drawings.)

Genus **GLYPTONYSIUS** Usinger, 1942:44

This endemic genus was erected to include two closely allied species, one from Kauai, the other from the adjacent island of Oahu. Its members have nearly naked dorsal surfaces in common with *Neseis* and *Oceanides,* but the antenniferous tubercles are enlarged and are subcarinate on their outer dorsal edges, and the hind margin of the metapleura is concave with the lateral angles produced; the head has the derm of its dorsum wrinkled, whereas it is smooth in *Neseis.*

Usinger made much of the subcarinate antenniferous tubercles and said (1942: 119) that the species have "a distinct ridge or carina on either side of the head extending onto the antenniferous tubercles, a character unique among the described Orsillini." It has been my experience that most workers overlook this character, because it is not, in my opinion, what one would call "distinct." In fact, it is usually rather vague and is comparative in degree. I have seen some users of the text misled by the overemphasis placed upon the distinctiveness of this character.

Usinger stated (1942:123) that *"Glyptonysius* is extremely rare, only half a dozen specimens of the genus having been collected," but I found the Kauai species to be one of the more common of the Orsillini in the highlands in 1937 (my specimens were not seen by Usinger). It is strange that more specimens have not been collected.

Key to the Species of Glyptonysius

1. Kauai species; anteocular part of head equal to length of an eye; pronotum only about one-seventh broader than head; length 3.44 to 4.22 mm..... **hylaeus** (Kirkaldy) Usinger.
2. Oahu species; anteocular part of head about one-third longer than an eye; pronotum about one-third broader than head; length 4.39 to 4.66 mm..... **laevigatus** Usinger.

Glyptonysius hylaeus (Kirkaldy) (fig. 27).

Nysius hylaeus Kirkaldy, 1910:539.

Glyptonysius hylaeus (Kirkaldy) Usinger, 1942:44, pl. 4, G. Genotype.

Endemic. Kauai (type locality: "Waimea Mts., 4000 ft.").

Hostplants: *Alyxia, Dubautia.*

Glyptonysius laevigatus Usinger (fig. 27).

Glyptonysius laevigatus Usinger, 1942:45, pl. 4, H.

Endemic. Oahu (type locality: Mount Tantalus, 2,000 feet).

Kirkaldy, and also Perkins (1912:735), considered this to be a variety of the Kauai form.

Genus **NESEIS** (Kirkaldy) Evans, 1929:354

This is the most complexly evolved group of Hawaiian Orsillini, for it contains, according to Usinger's treatment, 5 subgenera including 20 species, 12 subspecies and 2 varieties. Its naked or nearly naked dorsal surfaces, together with its punctate claval sutures and vein R+M, will separate it from *Nysius* and *Nesomartis;* its non-carinate, shorter antenniferous tubercles will separate it from *Glyptonysius;* and its concave posterior metapleural margin with its postero-lateral angle produced will serve to distinguish it from *Oceanides.* The head is smooth and polished in some species and rough in others.

Key to the Subgenera of Neseis

1. Eyes comparatively small, less than one-third, or about one-third, as broad as breadth of interocular area; head moderately elevated above, finely granular and clothed with an inconspicuous, subappressed, pale pubescence; body almost entirely pale yellowish to ochraceous with darker markings largely confined to head and ventral surfaces.. ..... **Icteronysius** Usinger.
   Eyes larger, more than one-third as broad as breadth of interocular area; color usually darker with more distinctive dark maculations or with head smooth, polished and almost or quite naked above..... 2
2(1). Head roughened by minute to distinct irregular granules, punctures or wrinkles and clothed with a more or less distinct, subappressed pubescence, at least anteriorly.... ..... **Trachynysius** Usinger.
   Head smooth, polished, naked above..... 3
3(2). Costal margins strongly dilated and rounded from just before level of apex of scutellum, not subparallel even at base; corium subopaque; membrane short, scarcely exceeding tip of abdomen..... **Physonysius** Usinger.
   Costal margins scarcely to distinctly arcuate but never before level of apex of scutellum, always subparallel subbasally; corium usually at least partially hyaline and membrane usually extending beyond apex of abdomen..... 4
4(3). Rostrum reaching to second ventrite, its third segment about one and one-half times as long as its second and nearly twice as long as fourth..... **Neseis** Kirkaldy.
   Rostrum reaching at most to middle of metacoxae, its third segment not distinctly longer than its second and subequal in length to fourth..... **Leionysius** Usinger.

Subgenus **Physonysius** Usinger, 1942:50

Key to the Species

1. Corium dark brown to piceous with femora variegated with, or entirely, pitchy brown; Maui..... **ampliatus** Usinger.
2. Color paler, flavous with dark-brown markings, legs pale and and often with brown-spotted femora; Molokai..... ..... **molokaiensis** Usinger.

Neseis (Physonysius) ampliatus Usinger (fig. 27).
Neseis (*Physonysius*) *ampliatus* Usinger, 1942:51, pl. 4, I. Type of *Physonysius*.

Endemic. Maui (type locality: Mount Haleakala, over 2,000 feet).
Hostplant: *Rubus*.

Neseis (Physonysius) molokaiensis Usinger (figs. 21, 27).
Neseis (*Physonysius*) *molokaiensis* Usinger, 1942:50, pl. 4, F.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).
Hostplant: *Freycinetia*.
The last nymphal instar is described and illustrated by Usinger (p. 149, pl. 12, C).

Subgenus **Leionysius** Usinger, 1942:52

KEY TO THE SPECIES

1. Pronotal disc distinctly convex caudad; distinctly maculated with fulvous and piceous, membrane embrowned on either side subbasally and at middle of apical half; size about 4.0 by 1.53 mm. ..... **haleakalae** (Perkins).
2. Pronotal disc subdepressed; rather uniformly pale except for eyes and commissure of clavus, membrane concolorous; size about 4.4 by 1.8 mm..... **pallidus** Usinger.

Neseis (Leionysius) haleakalae (Perkins) (fig. 27).
Nysius haleakalae Perkins, 1912:735.
Neseis (*Leionysius*) *haleakalae* (Perkins) Usinger, 1942:52, pl. 4, E. Type of *Leionysius*.

Endemic. Maui (type locality: Mount Haleakala, below 2,000 feet).

Neseis (Leionysius) pallidus Usinger (fig. 27).
Neseis (*Leionysius*) *pallidus* Usinger, 1942:53, pl. 4, D.

Endemic. Maui (type locality: Mount Haleakala, 9,400 feet).
Hostplant: *Styphelia*.

Subgenus **Neseis** Kirkaldy, 1910:537

Neseis (Neseis) kirkaldyi (Usinger) (fig. 27).
Nysius (*Neseis*) *monticola* Kirkaldy, 1910:544, not Distant, 1893.
Nysius kirkaldyi Usinger, 1937:443.
Neseis (*Neseis*) *kirkaldyi* (Usinger) Usinger, 1942:54, pl. 4, A. Type of subgenus.

Endemic. Maui (type locality: probably Mount Haleakala instead of West Maui as stated in the original description).

Hostplant: *Broussaisia.*

Subgenus **Trachynysius** Usinger, 1942:55

General Key to the Species

(Note: see also the following key, which is based upon localities.)

1. Eyes large, substylate; upper surface of head with broad, glabrous areas at middle and laterally near inner margins of eyes, these areas occupying most of upper surface of head; costal margins strongly dilated (fig. 31, *whitei*); Maui and Hawaii 2
   Eyes less strongly produced; upper surface of head with glabrous areas, when present, less extensive; costal margins less strongly dilated than in *whitei* (fig. 31) 3

2(1). Hemelytra long, membrane complete and extending beyond apex of abdomen for one-third of its length; Maui and Hawaii ..... **whitei whitei** (Blackburn).
   Hemelytra strongly abbreviated, membrane extending beyond apex of abdomen for less than one-third its length; Hawaii ..... **whitei brachypterus** Usinger.

3(1). Femora not spotted 4
   Femora brown- or black-spotted 5

4(3). Hind femora tinged with red distad; clavus and corium mostly opaque, black except at middle of costal margin; Oahu ..... **silvestris** (Kirkaldy).
   Hind femora not tinged with red; clavus and corium hyaline, either pale or lightly infuscated, corial apices brown; Oahu ..... **oahuensis** Usinger.

5(3). Largest species in genus, ranging from 5.16 mm. to 7.22 mm. in length; antennae very long, almost two-thirds longer than greatest width of pronotum behind; membrane uniformly, lightly infuscated; all high islands except Kauai ..... **saundersianus** (Kirkaldy).
   Usually much smaller or, if approaching in length *N. saundersianus,* either with antennae shorter, less than one-half longer than width of pronotum behind, or with membrane fuscofasciate at middle 6

6(5). Femora at middle and subapically and tibiae basally, apically, and at middle with distinct, black annulations; membrane with a very few, irregular brown spots; Kauai ..... **alternatus** Usinger.
   Femora brown-spotted with spots sometimes confluent and tibiae often infuscated apically but never as above 7

7(6). Rostrum passing posterior coxae, usually attaining second or third abdominal segment 8
   Rostrum not passing posterior coxae, usually only reaching middle coxae 15

8(7). Upper surface of head comparatively smooth, with only a few wrinkles, and naked except for a few inconspicuous hairs anteriorly; color tinged with fulvous; Oahu..... ..... **fulgidus** Usinger.
Upper surface of head, at least in part, rugosely punctate and with distinct, pale, appressed pubescence; color ochraceous with darker markings; all the high islands; *Neseis nitidus* subspecies 9

9(8). Size comparatively small, slender and short, 4.1 by 1.22 mm.; Oahu .....**nitidus contubernalis** Usinger.
Size always larger 10

10(9). Color almost entirely pale, ochraceous or yellowish, with pale-brown markings at apices of coria, on pronotum and on upper surface of head; pronotum typically relatively narrowed with sides feebly convex; Hawaii..... .....**nitidus comitans** (Perkins).
Color always darker, brownish-ochraceous, with more extensive black or dark-brown markings of hemelytra, pronotum and upper surface of head.....11

11(10). Pronotum relatively large and robust, distinctly longer than head on median line; broad, sides arcuate throughout their length except for a slight sinuation just behind callosities; humeral angles broadly rounded; Molokai.... .....**nitidus consummatus** Usinger.
Pronotum smaller, subequal in length to head or, if slightly longer, with sides almost straight, only feebly ampliate at level of callosities, and humeral angles more abruptly rounded 12

12(11). Kauai form; pronotum relatively short and broad, about as long as head.....**nitidus impressicollis** Usinger.
Not Kauai forms; pronotum longer than head.....13

13(12). Maui form.....**nitidus nitidus** (White).
Not so 14

14(13). Lanai form.....**nitidus insulicola** Usinger.
Hawaii form .....**nitidus pipturi** Usinger.

15(7). Head comparatively short, anteocular portion only two-thirds as long as an eye.....16
Head longer, produced in front of eyes for a distance greater than two-thirds length of an eye.....20

16(15). Pronotum strongly narrowed anteriorly, scarcely more ampliate at level of callosities; disc strongly convex behind transverse impression, posterior lobe distinctly, longitudinally fasciate at middle and sublaterally; costal margins scarcely convergent posteriorly; Hawaii and Lanai; *Neseis fasciatus* subspecies.....17
Pronotum more nearly subquadrate, lateral margins turned outward a little at level of callosities; disc only moderately convex or subflattened on posterior lobe and with only the usual brown spots at humeral angles and middle of posterior margin; Maui; *Neseis mauiensis* varieties 19

17(16). Pronotal disc strongly convex on posterior lobe; Lanai.. .....**fasciatus convergens** Usinger.
Pronotal disc only moderately convex on posterior lobe; Hawaii 18

18(17). Clavus and corium pale, subhyaline..... .....**fasciatus hyalinus** Usinger.
Clavus and corium in great part dark brown or black, subopaque.....**fasciatus fasciatus** Usinger.

19(16). Color in great part fuscous to black, callosities usually black; corium broadly infuscated, dark brown to black .....**mauiensis mauiensis** (Blackburn).
Color much paler, callosities sometimes brown; usually with a longitudinal pale line at middle of interocular region; corium infuscated only interruptedly on veins and narrowly at apex.....**mauiensis pallidipennis** Usinger.

20(15). Female genital cleft shallow, fourth visible ventral segment about half length of third at middle; body form relatively short and broad (35 to 38 percent as broad across hemelytra as long), appearing robust throughout; costal margins distinctly arcuate behind level of apex of scutellum, or more slender with costal margins more gradually arcuate throughout 21
Female genital cleft deeper, fourth visible ventral segment nearly concealed or concealed beneath third at middle; body more slender (31 to 33 percent as broad across hemelytra as long), sides subparallel; costal margins of coria only feebly arcuate beyond apex of scutellum.....23

21(20). Costal margins scarcely sinuate subbasally and at level of apex of scutellum, otherwise moderately evenly arcuate; ground color, including upper surface of head, pale brown; pronotum extensively, distinctly punctate on posterior lobe; Molokai.....**cryptus** Usinger.
Costal margins distinctly dilated beyond level of apex of scutellum; ground color reddish or ochraceous with black upper surface of head and other maculations.....22

22(21). Size large, 4.7 to 5.3 mm.; distinctly tinged with red, clavus brown only narrowly on commissure, and corium brown only near outer apical angle; Molokai.....**swezeyi** Usinger.
Size smaller, 4.25 to 4.5 mm.; brownish-ochraceous marked with black on apical third of clavus and on inner apical portion of corium between vein Cu and clavus, and on inner apical portion of corium between vein Cu and claval suture; Molokai.....**chinai** Usinger.

23(20). Eyes small, distinctly less than half width of interocular space (eyes measured to inner line of ommatidia); juga very large, their outer sides, as viewed from above, nearly or distinctly convex; Oahu, Molokai.....24
Eyes larger, nearly half as wide as interocular space; juga with concave side margins; Hawaii, Maui.....25

24(23). Eyes measured from inner row of ommatidia only slightly if any wider than one-third breadth of interocular area;

pronotum with a dark vitta on median line and between median line and sides; first rostral segment reaching only about as far back as fore part of eye; Oahu.....
.....**hiloensis jugatus** Usinger.

Eyes distinctly more than one-third as broad as interocular area; pronotum not vittate; first rostral segment nearly reaching base of head.....**hiloensis interoculatus** Usinger.

25(23). Small (3.54 to 4.22 mm. by 1.28 to 1.44 mm.), slender, pale species; markings pale brown and confined to apices of coria, membrane, humeral angles and middle of posterior margin of pronotum; Hawaii.....
.....**hiloensis hiloensis** (Perkins).

Larger, proportionately broader, and ochraceous with more extensive dark fuscous to black markings on hemelytra...*26*

26(25). Anteocular part of head very nearly as long as an eye; interocular space a little elevated along middle; lateral margins of pronotum moderately but distinctly ampliate at level of callosities; Maui.....
.....**hiloensis approximatus** Usinger.

Anteocular part of head distinctly shorter than an eye; interocular space subdepressed and flattened; lateral margins of pronotum almost straight, scarcely ampliate at level of callosities; Hawaii...**hiloensis intermedius** Usinger.

Because the species and lesser forms of *Trachynysius* are difficult to distinguish, I have felt it desirable to prepare a second key in which geographical distribution has been used as a primary character to split the assemblage into small groups. Excepting *saundersianus,* each of the forms is restricted to a single island. Hence, the reader may find this second set of keys of considerable help in more quickly determining a collection of specimens from a single locality.

Island Keys for the Separation of the Forms of Trachynysius

SECTION A—KEY TO THE KAUAI TRACHYNYSIUS

1. Legs with spots condensed to form black annulations at middle and subapically on femora, basad, mesad and distad on tibiae; rostrum reaching posterior coxae.....
..... **alternatus** Usinger.

2. Legs with many distinct spots, but not banded; rostrum reaching far behind metacoxae.....
.....**nitidus impressicollis** Usinger.

SECTION B—KEY TO THE OAHU TRACHYNYSIUS

1. Femora not spotted 2
Femora with distinct dark spots..... 3

2(1). Hind femora tinged with red distad; clavus and corium mostly opaque, black, except at middle of costal margins
.....**silvestris** (Kirkaldy).

Hind femora not tinged with red; clavus and corium hyaline, either pale or lightly infuscated, corial apices brown
.....**oahuensis** Usinger.

3(1). A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth; wing membrane uniformly, lightly infuscated..... .....**saundersianus** (Kirkaldy).
Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with wing membrane fusco-fasciate at middle..... 4

4(3). Rostrum reaching only middle coxae or hind coxae, but not surpassing hind coxae.....**hiloensis jugatus** Usinger.
Rostrum extending behind metacoxae..... 5

5(4). Dorsum of head comparatively smooth and bare except for a few inconspicuous hairs anteriorly; color tinged with fulvous .....**fulgidus** Usinger.
Dorsum of head, at least in part, rugosely sculptured and with distinct, pale, appressed pubescence; color ochraceous with darker markings...**nitidus contubernalis** Usinger.

SECTION C—KEY TO THE MOLOKAI TRACHYNYSIUS

1. A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth; wing membrane uniformly lightly infuscated..... ..... **saundersianus** (Kirkaldy).
Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with wing membrane fusco-fasciate at middle..... 2

2(1). Rostrum extending behind metacoxae..... .....**nitidus consummatus** Usinger.
Rostrum reaching meso- or metacoxae, but not extending behind metacoxae 3

3(2). Female genital cleft deep, fourth visible ventral segment nearly concealed or concealed beneath third at middle; body comparatively slender (31 to 33 percent as broad across hemelytra as long), sides subparallel; costal margins of coria only feebly arcuate beyond apex of scutellum.....**hiloensis interoculatus** Usinger.
Female genital cleft shallower, fourth visible ventral segment about half length of third at middle..... 4

4(3). Costal margins scarcely sinuate subbasally and at level of apex of scutellum, otherwise moderately evenly arcuate; ground color, including upper surface of head, pale brown; pronotum extensively distinctly punctate on posterior lobe .....**cryptus** Usinger.
Costal margins distinctly dilated beyond level of apex of scutellum; ground color reddish or ochraceous with black upper surface of head and other maculations..... 5

5(4). Length 4.7 to 5.3 mm.; distinctly tinged with reddish, clavus brown only narrowly on commissure and corium brown only near outer apical angle.....**swezeyi** Usinger.
Length shorter, 4.27 to 4.5 mm.; brownish-ochraceous marked with black on apical third of clavus and on inner apical portion of corium between vein Cu and claval suture .....**chinai** Usinger.

SECTION D—KEY TO THE LANAI TRACHYNYSIUS

1. A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth; hemelytral membrane uniformly lightly infuscated..... ..... **saundersianus** (Kirkaldy).
Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with hemelytral membrane fusco-fasciate at middle..... 2
2. Rostrum extending to about middle of second abdominal sternite; pronotum not vittate..**nitidus insulicola** (Kirkaldy)
Rostrum not reaching metacoxae; pronotum vittate..... .....**fasciatus convergens** Usinger.

SECTION E—KEY TO THE MAUI TRACHYNYSIUS

1. A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth; hemelytral membrane uniformly lightly infuscated..... .....**saundersianus** (Kirkaldy).
Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with hemelytral membrane fusco-fasciate at middle..... 2
2(1). Rostrum extending behind metacoxae..**nitidus nitidus** (White).
Rostrum not reaching hind margin of metacoxae..... 3
3(2). Anteocular part of head more than two-thirds as long as an eye.....**hiloensis approximatus** Usinger.
Head short, anteocular part only about two-thirds as long as an eye 4
4(3). Mostly fuscous to black, pronotal callosities usually black, corium broadly infuscated, dark brown to black..... .....**mauiensis mauiensis** (Blackburn).
Paler forms, pronotal callosities sometimes brown, usually with a longitudinal pale line at middle of interocular region, corium infuscated only interruptedly on veins and narrowly at apex.....**mauiensis pallidipennis** Usinger.

SECTION F—KEY TO THE HAWAII TRACHYNYSIUS

1. Eyes large, substylate; upper surface of head with broad, glabrous areas at middle and laterally near inner margins of eyes, these areas occupying most of upper surface of head; costal margins strongly dilated (fig. 31, *whitei*)..... 2
Eyes less strongly produced; upper surface of head with glabrous areas, when present, less extensive; costal margins less strongly dilated (fig. 30, *saundersianus,* for example) 3
2(1). Hemelytra long, membrane complete and exceeding tip of abdomen by one-third its length...**whitei whitei** (Blackburn).
Hemelytra strongly abbreviated, membrane exceeding tip of abdomen by less than one-third its length..... .....**whitei brachypterus** Usinger.

3(1). A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth; hemelytral membrane uniformly lightly infuscated..... ..... **saundersianus** (Kirkaldy).

Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with hemelytral membrane fusco-fasciate at middle..... 4

4(3). Rostrum extending behind metacoxae..... 5

Rostrum not reaching beyond metacoxae..... 6

5(4). Predominantly pale species, mostly yellow, dark coloring on crown of head brown, not even base black..... .....**nitidus comitans** (Perkins).

Pale brown to ochraceous species, dark coloring on crown of head black or brown with at least some black basad... .....**nitidus pipturi** Usinger.

6(4). Anteocular area of head only about two-thirds length of an eye; pronotum usually multi-vittate or subvittate..... 7

Anteocular area of head more than two-thirds length of an eye; pronotum not vittate..... 8

7(6). Clavus and corium for most part dark..... .....**fasciatus fasciatus** Usinger.

Clavus and corium mostly pale.....**fasciatus hyalinus** Usinger.

8(6). Sides of pleura brown, not black; abdomen not extensively black.....**hiloensis hiloensis** (Perkins).

Sides of pleura black, not brown; abdomen with extensive black coloring.....**hiloensis intermedius** Usinger.

Neseis (Trachynysius) alternatus Usinger (fig. 27).
Neseis (Trachynysius) alternatus Usinger, 1942:76, pl. 6, F.

Endemic. Kauai (type locality: Halemanu).
Hostplant: *Pterotropia.*

Neseis (Trachynysius) chinai Usinger (fig. 28).
Neseis (Trachynysius) chinai Usinger, 1942:78, pl. 5, E.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).

Neseis (Trachynysius) cryptus Usinger (fig. 28).
Neseis (Trachynysius) cryptus Usinger, 1942:58, pl. 5, A.

Endemic. Molokai (type locality: Mapulehu Valley).

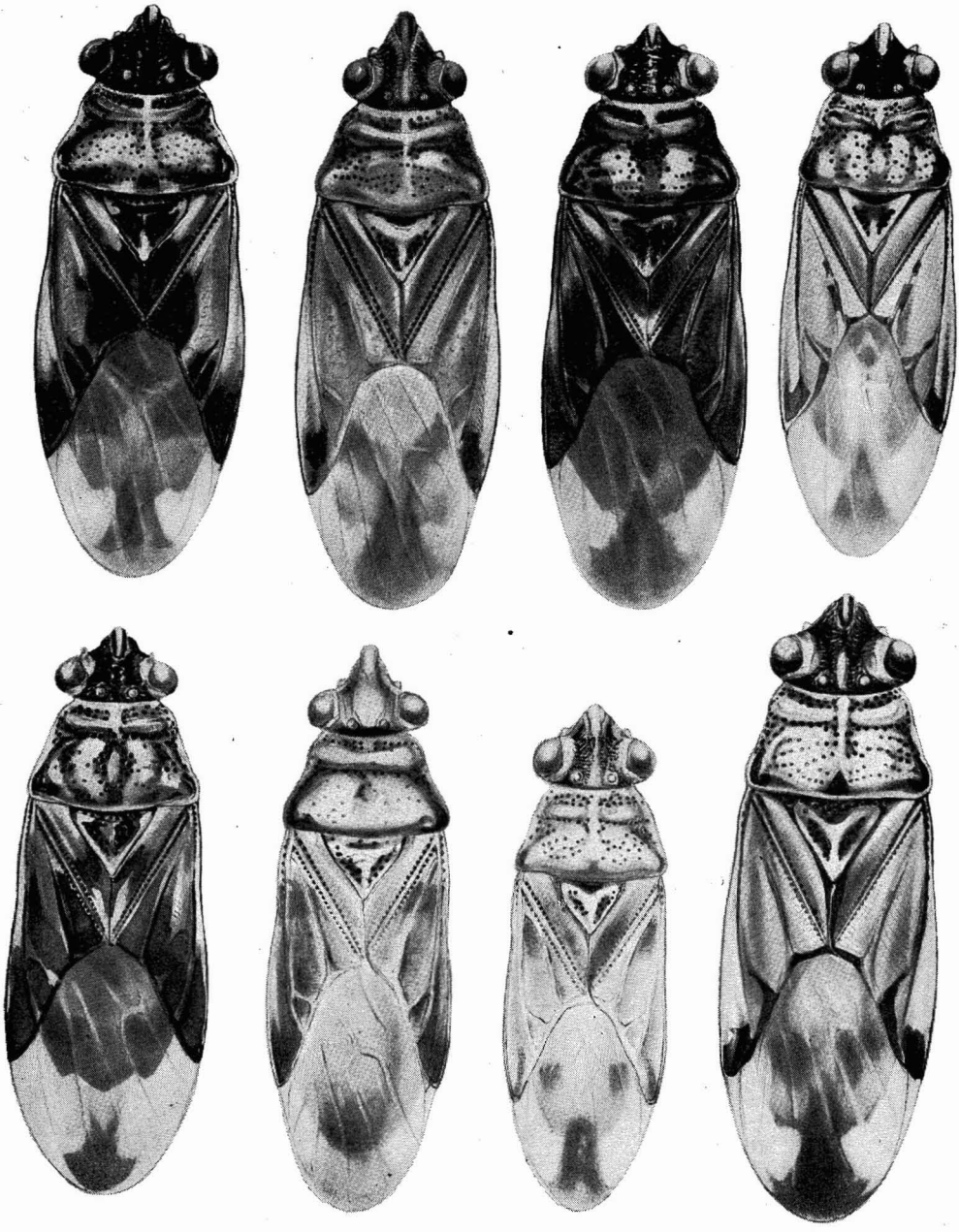

Figure 28—Some species of *Neseis* (*Trachynysius*). Top row, left to right: *N.* (*T.*) *chinai* Usinger, paratype female; *N.* (*T.*) *cryptus* Usinger, holotype female; *N.* (*T.*) *fasciatus fasciatus* Usinger, allotype female; *N.* (*T.*) *fasciatus fasciatus hyalinus* Usinger, holotype male. Bottom row, left to right: *N.* (*T.*) *fasciatus convergens* Usinger, allotype female; *N.* (*T.*) *fulgidus* Usinger, paratype female; *N.* (*T.*) *hiloensis hiloensis* (Perkins), male; *N.* (*T.*) *hiloensis approximatus* Usinger, allotype female. (Rearranged from Usinger's original Abernathy drawings.)

Neseis (Trachynysius) fasciatus fasciatus Usinger (figs. 21, 28).
Neseis (Trachynysius) fasciatus fasciatus Usinger, 1942:80, pl. 6, A.

Endemic. Hawaii (type locality: Kilauea).
Hostplants: *Coprosma, Myrsine, Straussia.*
The last nymphal instar was figured and described by Usinger, p. 151, pl. 12, D.

Neseis (Trachynysius) fasciatus fasciatus hyalinus Usinger (fig. 28).
Neseis (Trachynysius) fasciatus fasciatus variety *hyalinus* Usinger, 1942:81, pl. 6, B.

Endemic. Hawaii (type locality: North Kona, 3,790 feet).
Hostplants: *Coprosma, Pelea, Straussia.*

Neseis (Trachynysius) fasciatus convergens Usinger (fig. 28).
Neseis (Trachynysius) fasciatus subspecies *convergens* Usinger, 1942:81, pl. 6, C.

Endemic. Lanai (type locality).

Neseis (Trachynysius) fulgidus Usinger (figs. 21, 28).
Neseis (Trachynysius) fulgidus Usinger, 1942:59, pl. 5, B.

Endemic. Oahu (type locality: mountains above Punaluu).
Hostplants: *Coprosma, Pipturus.*
Usinger described and figured the last nymphal instar (p. 150, pl. 12, E).

Neseis (Trachynysius) hiloensis hiloensis (Perkins) (fig. 28).
Nysius hiloensis Perkins, 1912:735.
Neseis (Trachynysius) hiloensis hiloensis (Perkins) Usinger, 1942:72, pl. 6, I.

Endemic. Hawaii (type locality: "Hilo, about 1200 ft.").

Neseis (Trachynysius) hiloensis approximatus Usinger (fig. 28).
Neseis (Trachynysius) hiloensis subspecies *approximatus* Usinger, 1942:70, pl. 6, H.

Endemic. Maui (type locality: Waihee Valley, 50 feet).
Hostplants: *Pipturus, Sideroxylon.*

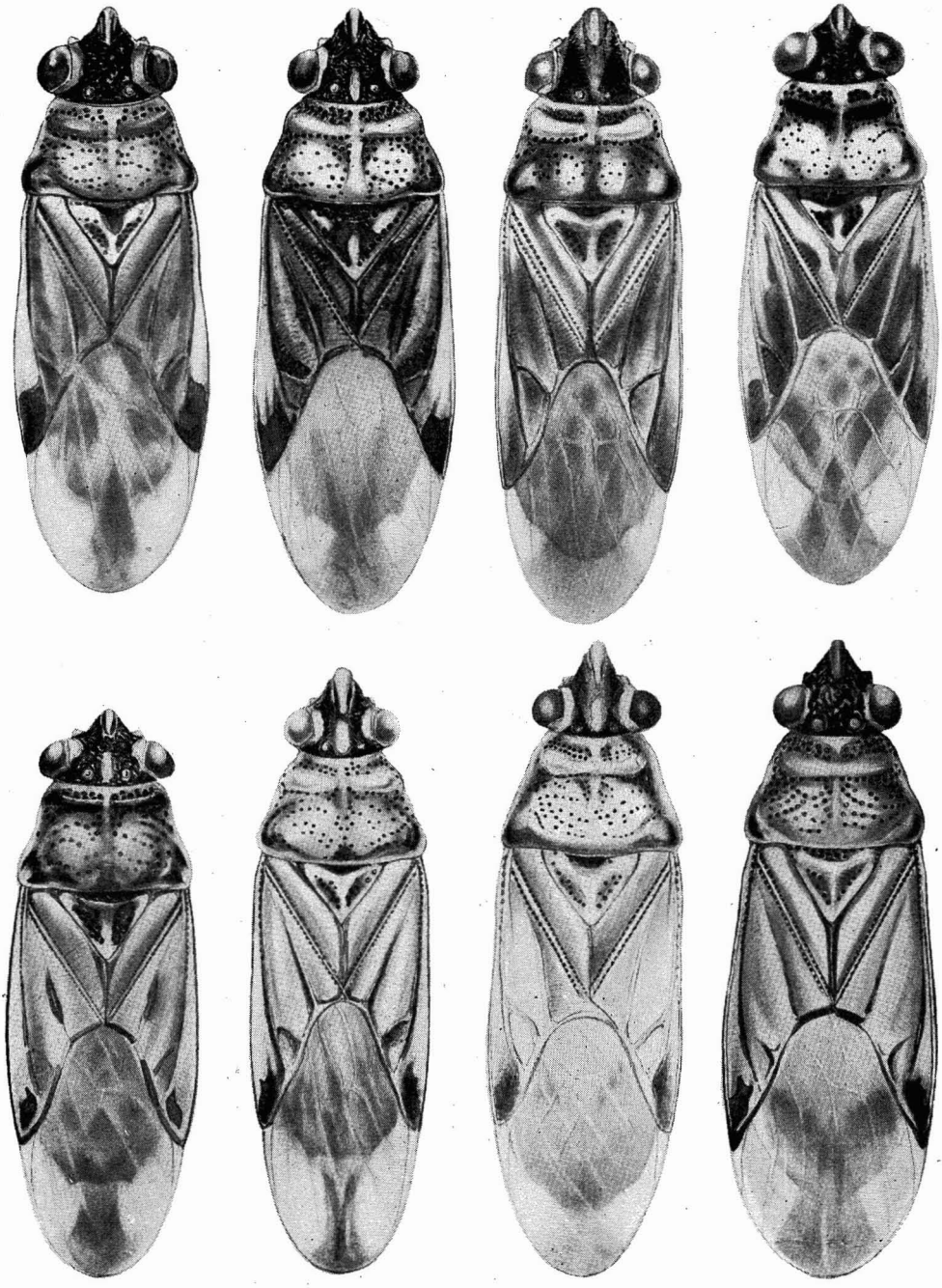

Figure 29—Some *Neseis* (*Trachynysius*). Top row, left to right: *N.* (*T.*) *hiloensis intermedius* Usinger, paratype male; *N.* (*T.*) *hiloensis interoculatus* Usinger, holotype female; *N.* (*T.*) *hiloensis jugatus* Usinger, female; *N.* (*T.*) *mauiensis mauiensis* (Blackburn), female. Bottom row, left to right: *N.* (*T.*) *mauiensis pallidipennis* Usinger, holotype male; *N.* (*T.*) *nitidus nitidus* (White), male; *N.* (*T.*) *nitidus comitans* (Perkins), female; *N.* (*T.*) *nitidus consummatus* Usinger, holotype male. (Rearranged from Usinger's original Abernathy drawings.)

Neseis (Trachynysius) hiloensis intermedius Usinger (fig. 29).
Neseis (Trachynysius) hiloensis subspecies *intermedius* Usinger, 1942:71, pl. 6, J.

Endemic. Hawaii (type locality: Kilauea).
Hostplants: *Pipturus,* ferns.

Neseis (Trachynysius) hiloensis interoculatus Usinger (fig. 29).
Neseis (Trachynysius) hiloensis subspecies *interoculatus* Usinger, 1942:69, pl. 6, K.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).
Hostplant: *Pipturus.*

Neseis (Trachynysius) hiloensis jugatus Usinger (fig. 29).
Neseis (Trachynysius) hiloensis subspecies *jugatus* Usinger, 1942:68, pl. 6, L.

Endemic. Oahu (type locality: mountains behind Punaluu).
Hostplant: *Pipturus.*

Neseis (Trachynysius) mauiensis mauiensis (Blackburn) (fig. 29).
Nysius mauiensis Blackburn, 1888:345.
Neseis (Trachynysius) mauiensis mauiensis (Blackburn) Usinger, 1942:79, pl. 6, E.
Kirkaldy, 1908:190; 1910:538. Perkins, 1912:732, misspelled *maniensis.*

Endemic. Maui (type locality: Mount Haleakala, 4,500 feet).
Hostplants: *Cheirodendron, Clermontia arborescens, Coprosma, Pelea, Rubus.*
Perkins recorded this species from Hawaii and Lanai, but Usinger lists it as confined to Maui.

Neseis (Trachynysius) mauiensis pallidipennis Usinger (fig. 29).
Neseis (Trachynysius) mauiensis variety *pallidipennis* Usinger, 1942:80, pl. 6, D.

Endemic. Maui (type locality: Waikamoi).

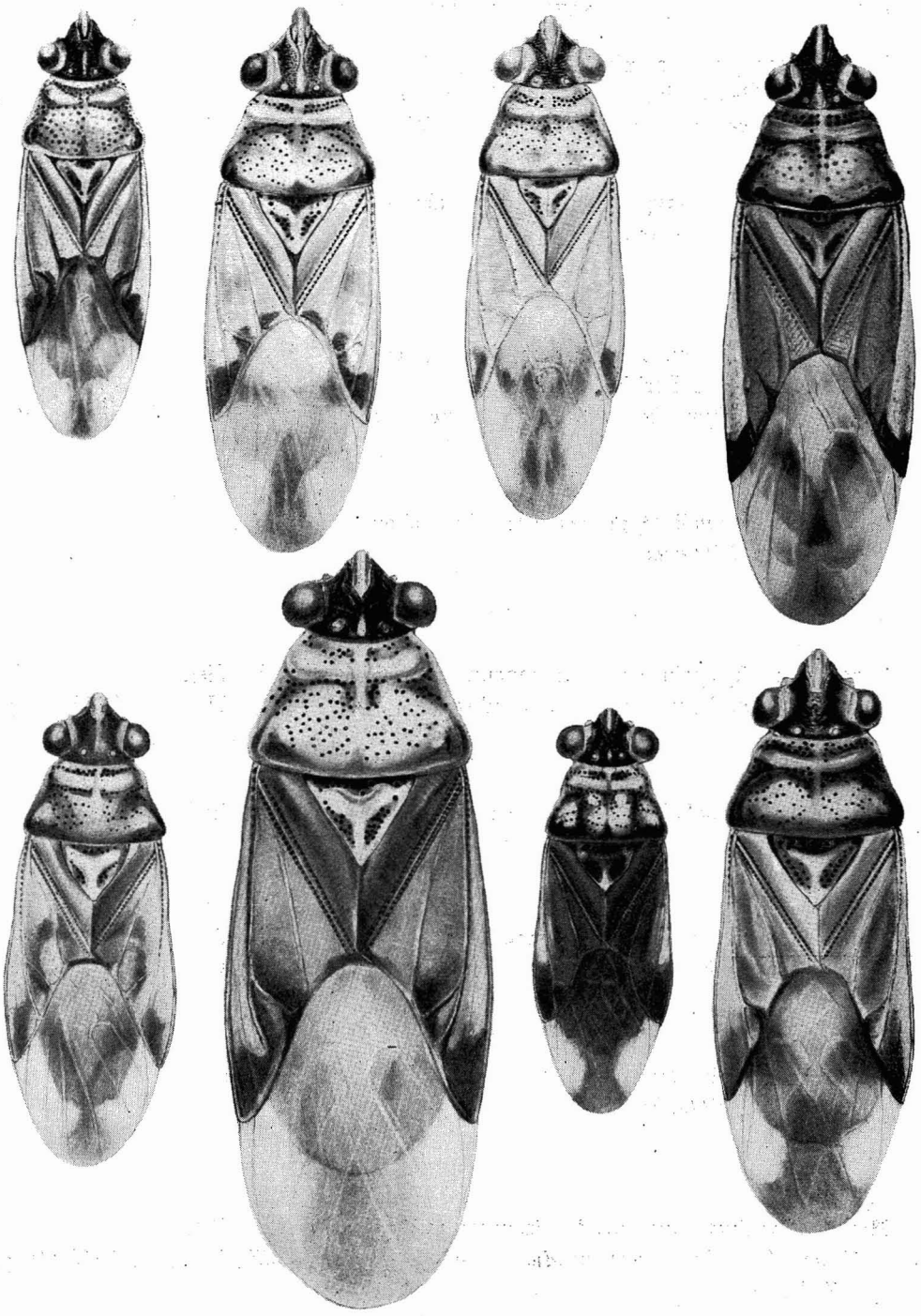

Figure 30—*Neseis* (*Trachynysius*). Top row, left to right: *N.* (*T.*) *nitidus contubernalis* Usinger, male; *N.* (*T.*) *nitidus impressicollis* Usinger, paratype female; *N.* (*T.*) *nitidus insulicola* (Kirkaldy), male; *N.* (*T.*) *nitidus pipturi* Usinger, female. Bottom row, left to right: *N.* (*T.*) *oahuensis* Usinger, paratype female; *N.* (*T.*) *saundersianus* (Kirkaldy), male; *N.* (*T.*) *silvestris* (Kirkaldy), male; *N.* (*T.*) *swezeyi* Usinger, female. (Rearranged from Usinger's original Abernathy drawings.)

Neseis (Trachynysius) nitidus nitidus (White) (fig. 29).
Nysius nitidus White, 1881:53. Kirkaldy, 1908:190; 1910:543. Perkins, 1912:732.
Neseis (Trachynysius) nitidus nitidus (White) Usinger, 1942:64, pl. 7, G.

Endemic. Maui (type locality: Haleakala, 4,000 feet).
Hostplants: *Pipturus* (?), *Urera.*

Neseis (Trachynysius) nitidus comitans (Perkins) (fig. 29).
Nysius comitans Perkins, 1912:736.
Neseis (Trachynysius) nitidus subspecies *comitans* (Perkins) Usinger, 1942:66, pl. 7, A.

Endemic. Hawaii (type locality: "Hilo, about 1200 ft.").
Hostplant: *Pipturus.*

Neseis (Trachynysius) nitidus consummatus Usinger (fig. 29).
Neseis (Trachynysius) nitidus subspecies *consummatus* Usinger, 1942:62, pl. 7, C.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).

Neseis (Trachynysius) nitidus contubernalis Usinger (fig. 30).
Neseis (Trachynysius) nitidus subspecies *contubernalis* Usinger, 1942:61, pl. 7, B.

Endemic. Oahu (type locality: mountains behind Punaluu).
Hostplant: *Pipturus.*

Neseis (Trachynysius) nitidus impressicollis Usinger (fig. 30).
Neseis (Trachynysius) nitidus subspecies *impressicollis* Usinger, 1942:60, pl. 7, D.

Endemic. Kauai (type locality: Kumuweia).
Hostplants: *Cyrtandra, Dodonaea, Osmanthus, Pipturus.*

Neseis (Trachynysius) nitidus insulicola (Kirkaldy) (fig. 30).
Nysius insulicola Kirkaldy, 1910:541.
Neseis (Trachynysius) nitidus subspecies *insulicola* (Kirkaldy) Usinger, 1942:63, pl. 7, E.

Endemic. Lanai (type locality: "over 2000 ft.").

Neseis (Trachynysius) nitidus pipturi Usinger (fig. 30).
Neseis (Trachynysius) nitidus subspecies *pipturi* Usinger, 1942:65, pl. 7, F.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Pipturus.*
Usinger described the fifth nymphal instar (p. 151).

Neseis (Trachynysius) oahuensis Usinger (fig. 30).
Neseis (Trachynysius) oahuensis Usinger, 1942:57, pl. 5, C.
Endemic. Oahu (type locality: Manoa–Palolo Ridge).

Hostplant: *Boehmeria grandis.*
The egg and first nymphal instar have been described by Usinger (p. 150).

Neseis (Trachynysius) saundersianus (Kirkaldy) (figs. 22, c; 30).
Nysius saundersianus Kirkaldy, 1902:163; 1908:189; 1910:537.
Nysius saundersi, misspelling by Perkins, 1913:cxcv.
Neseis (Trachynysius) saundersianus (Kirkaldy) Usinger, 1942:74, pl. 5, F.

Endemic. Oahu, Molokai, Lanai, Maui, Hawaii. (No type locality designated.)
Hostplants: *Broussonetia, Claoxylon, Coprosma, Freycinetia, Sapindus, Urera.*

Neseis (Trachynysius) silvestris (Kirkaldy) (fig. 30).
Nysius silvestris Kirkaldy, 1910:541.
Neseis (Trachynysius) silvestris (Kirkaldy) Usinger, 1942:77, pl. 6, G.

Endemic. Oahu (type locality: "Waianae Mts., about 3000 ft.").
Hostplant: *Straussia.*

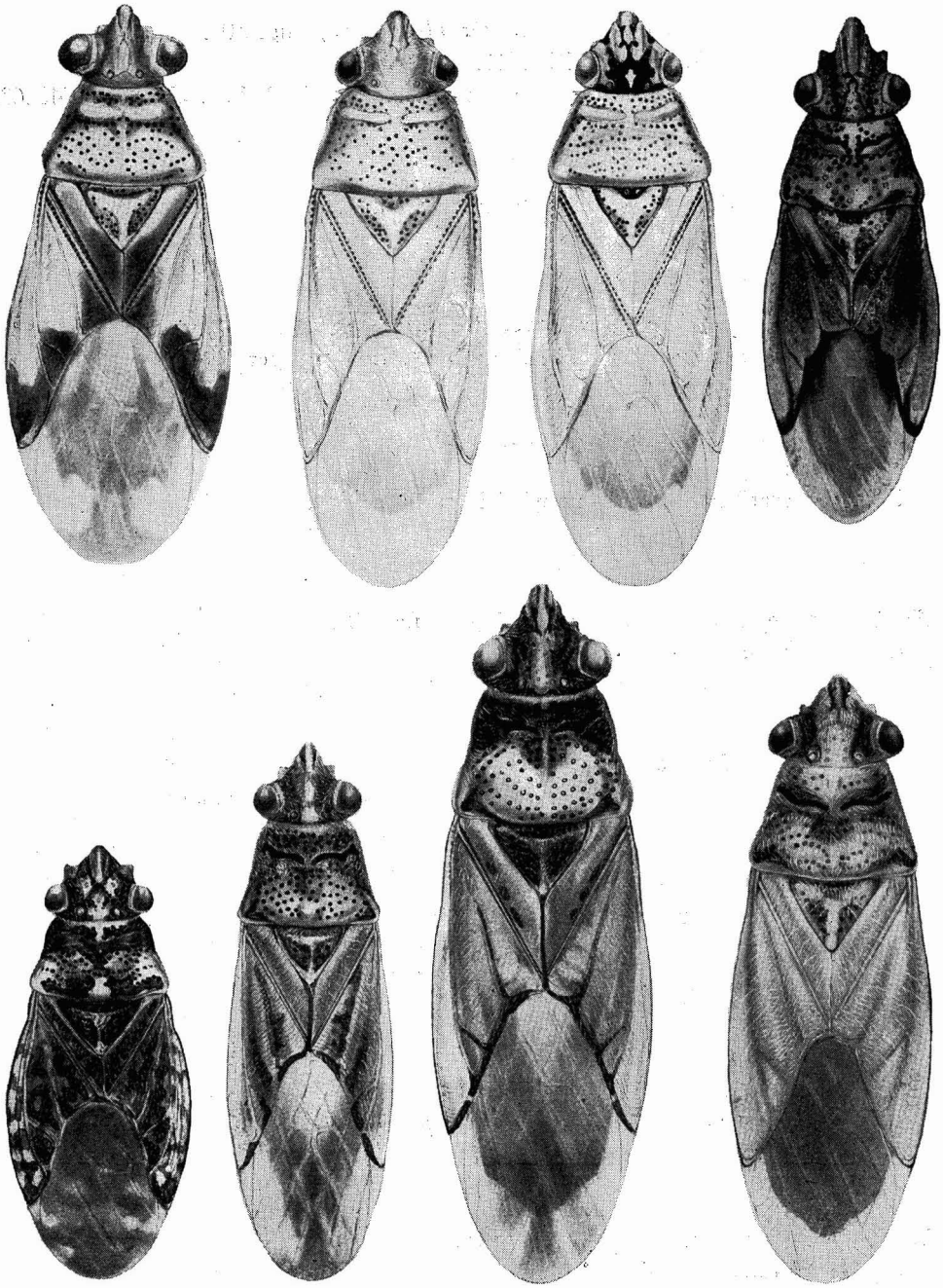

Figure 31—Some Orsillini. Top row, left to right: *Neseis* (*Trachynysius*) *whitei whitei* (Blackburn), female; *Neseis* (*Icteronysius*) *ochriasis ochriasis* (Kirkaldy), female; *Neseis* (*Icteronysius*) *ochriasis maculiceps* (Usinger), female; *Nysius abnormis* Usinger, holotype male. Bottom row, left to right: *Nysius blackburni* White, female; *Nysius coenosulus* Stål, male; *Nysius communis* Usinger, female; *Nysius dallasi* White, female. (Rearranged from Usinger's original Abernathy drawings.)

Neseis (Trachynysius) swezeyi Usinger (fig. 30).
Neseis (*Trachynysius*) *swezeyi* Usinger, 1942:73, pl. 5, G.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).
Hostplant: *Pipturus.*

Neseis (Trachynysius) whitei whitei (Blackburn) (fig. 31).
Nysius whitei Blackburn, 1888:346. Kirkaldy, 1908:190; 1910:538. Perkins, 1912:733, redescription.
Neseis (*Trachynysius*) *whitei whitei* (Blackburn) Usinger, 1942:55, pl. 5, D.

Endemic. Hawaii (type locality, Mauna Loa, 4,000 feet).

Neseis (Trachynysius) whitei brachypterus Usinger (fig. 32).
Neseis (*Trachynysius*) *whitei* subspecies *brachypterus* Usinger, 1942:56.

Endemic. Hawaii (type locality: Nauhi Gulch, 5,000–6,000 feet).
Hostplant: *Astelia.*
The shortening of the wings of this species is a noteworthy evolutionary tendency.

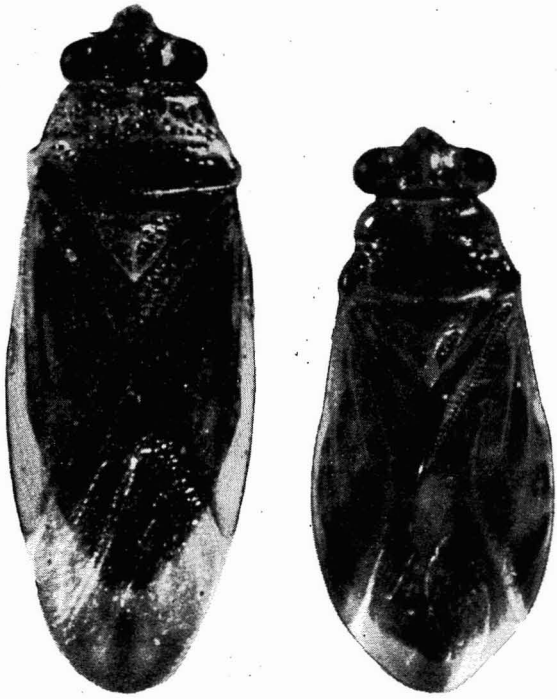

Figure 32—*Neseis* (*Icteronysius*) *ochriasis baldwini* Usinger, allotype female, left. *Neseis* (*Trachynysius*) *whitei brachypterus* Usinger, paratype female, right.

Subgenus **Icteronysius** Usinger, 1942:82

Usinger, 1945:405, notes.

KEY TO THE SUBSPECIES

1. Maui form.....**ochriasis baldwini** Usinger.
   Hawaii forms 2
2. Rostrum only reaching middle of metacoxae; head maculations ill-defined, pale brown.....**ochriasis ochriasis** (Kirkaldy).
   Rostrum extending to about middle of ventrite two; head maculations prominent, black.....**ochriasis maculiceps** (Usinger).

Neseis (Icteronysius) ochriasis ochriasis (Kirkaldy) (fig. 31).
Nysius ochriasis Kirkaldy, 1902:162; 1910:541. Perkins, 1912:734.
Neseis (Icteronysius) ochriasis (Kirkaldy) Usinger, 1942:83, pl. 4, C.
Neseis (Icteronysius) ochriasis ochriasis (Kirkaldy) Usinger, 1945:405. Type of *Icteronysius.*

Endemic. Hawaii (type series from Hualalai, 8,000 feet, and Kilauea).
Hostplants: *Dubautia, Raillardia, Sophora, Pelea.* Perhaps all these plants except *Sophora* were recorded from accidental captures and are not true hosts.

Neseis (Icteronysius) ochriasis baldwini Usinger (fig. 32).
Neseis (Icteronysius) ochriasis subspecies *baldwini* Usinger, 1945:405.

Endemic. Maui (type locality: Waikekeehia, Mount Haleakala, 6,300 feet).
Hostplant: *Sophora.*

Neseis (Icteronysius) ochriasis maculiceps (Usinger) (figs. 21, 31).
Neseis (Icteronysius) maculiceps Usinger, 1942:84, pl. 4, B.
Neseis (Icteronysius) ochriasis subspecies *maculiceps* (Usinger) Usinger, 1945:405.

Endemic. Hawaii (type locality: Humuula, about 8,000 feet).
Hostplant: *Sophora.*
Usinger described and figured the last nymphal instar (p. 149, pl. 12, B).

Genus **NYSIUS** Dallas, 1852:551

Usinger, 1942:84, detailed redescription.

This is a cosmopolitan genus which has a greater development in Hawaii than in any one other area. There are now 22 species, one subspecies and one variety recognized as Hawaiian. Here it shares with *Nesomartis* the comparatively conspicuous pubescence and erect setae which clothe the greater part of the dorsal surfaces. The breadth of the head across the eyes is, however, less than the breadth of the pronotum (it is greater on *Nesomartis*). The hind margins of the metapleura are concave with the postero-lateral angle rounded off. The elevated parts of the bucculae extend back to about half way between the anterior part of the antenniferous tubercles and the base of the head, whereas they do not extend much if any behind the fore edges of the antenniferous tubercles in *Oceanides, Glyptonysius* and *Neseis*.

Usinger (1942:119) says that in Hawaii "a wider range of characters is exhibited by these species [of *Nysius*] than in the combined *Nysius* fauna of the rest of the world. Such characters as form of bucculae, length of rostrum, and shape of costal margins, which are fairly reliable guides to genera elsewhere, break down completely in the various extreme species of Hawaiian *Nysius*."

Unlike the other genera of Hawaiian Orsillini, most of the members of this genus are not uni-insular in their distribution but are found on two to several islands; one species has been found on seven islands and probably occurs on more. For this reason I have not been able to make a second set of keys based primarily on geographical distribution.

Keys to the Hawaiian Nysius

Main island species.....Section A
Leeward island species.....Section B

SECTION A.—THE MAIN ISLAND FORMS

1. Rostrum distinctly surpassing posterior coxae, reaching apex of second abdominal segment or attaining fourth or sixth ventrite (except in female of *communis*, in which it may extend hardly beyond middle of second ventrite)..... 2
   Rostrum shorter, not or scarcely passing posterior coxae, at most not passing middle of second ventrite..... 4

2(1). Head about as long as broad across eyes, rostrum reaching sixth abdominal segment; relatively small, 3.77 mm., with considerable ferrugineous color above; Molokai.....
.....**abnormis** Usinger.
   Head broader than long; rostrum shorter; color fulvous or testaceous above 3

3(2). Pale color largely fulvous; membrane distinctly fusco-fasciate along middle.....**communis** Usinger.
Pale color of pronotum and hemelytra either clear hyaline or testaceous; membrane immaculate or nearly so; Kauai .....**mixtus** Usinger.

4(1). Anteocular part of head very long, about half again as long as an eye or almost twice as long as an eye (measure carefully with eye-piece micrometer); corium clothed with short, appressed, pale pubescence imparting a grayish cast to the insect; without conspicuous erect hairs..... 5
Anteocular part of head much shorter, about as long as an eye or at most one-fourth longer; corium often with conspicuous erect hairs as well as subappressed hairs..... 7

5(4). Femora usually dark brown to pitchy black except at apices; pronotal disc with irregularly spaced punctures interspersed with irregular smooth areas posteriorly; Maui and Hawaii.....**lichenicola** Kirkaldy.
Femora uniformly fulvous or distinctly brown-spotted; pronotal disc densely covered with small punctures..... 6

6(5). Eyes located posteriorly, very near level of posterior margin of head; pronotum subcylindrical, at least anteriorly; scutellum about as long as broad; claval suture bounded on either side by a row of distinct punctures and vein R of corium with a distinct row of punctures throughout its length, best seen in side view; costal margins strongly explanate; Oahu and Maui.....**sublittoralis** Perkins.
Eyes located a little farther forward, posterior margin of head rounded laterally to eyes; pronotum subflattened or at least feebly, roundly carinate laterally on anterior lobe; claval suture and corial vein R impunctate or at least without conspicuous punctures and costal margins less strongly expanded; Kauai, Oahu, Maui, Hawaii, Nihoa .....**longicollis** Blackburn.

7(4). Rostrum reaching only middle coxae; species of intermediate size with immaculate or only faintly infuscated membrane; head black except for a narrow pale spot or line at middle of hind margin above and along tylus; scutellum black except at apex; clavus and corium with backwardly directed, inconspicuous, suberect hairs; all (?) main islands.....**nigriscutellatus** Usinger.
Rostrum reaching or passing posterior coxae..... 8

8(7). Costal margins strongly dilated, body form comparatively short and broad posteriorly; pronotum subcylindrical anteriorly and relatively strongly convex; femora either entirely pale fulvous or paler with only an occasional brown spot or entirely brown with irregular darker brown spots or markings..... 9
Sides of body more nearly subparallel; femora yellowish or testaceous with distinct spots or markings (sometimes entirely black except at apices in *nemorivagus* and *blackburni*, both of which have a broad, subflattened pronotum) 10

9(8). Color above rufescent marked with black; pronotum only moderately convex; claval suture and corial vein R without visible punctures except near base; membrane almost entirely clear hyaline; femora pale fulvous or paler with only a few spots; Hawaii.....**rubescens** White.

Color dark brown above with black markings and pale mainly along expanded costal margins and at middle of membrane basally; pronotum very strongly convex; claval suture and corial vein R with rows of punctures which are only distinct under high magnification; membrane broadly dark brown on either side near middle of apices of coria and continuing posteriorly to apex; femora generally dark brown with still darker spots or markings visible; Oahu.....**fucatus** Usinger.

10(8). Fourth antennal segment very long, almost half again as long as third; small species (3 to 4 mm. long) with almost entirely black undersurfaces and appendages; upper surface variable, black to ferrugineous; Maui, Hawaii, Molokai (?).....**blackburni** White.

Fourth antennal segment scarcely longer than third.....11

11(10). Color in great part dark brown to black, with paler markings on head and pronotum; clavus and corium irregularly marked with paler spots; entire expanded costal area intruding to apical margin of corium at its junction with radial vein, pale; antennae black.....
.....**nemorivagus** White.

Corium often marked with fuscous but with pale color always predominant; antennae at least partly paler.....12

12(11). Length 3.5 to 4 mm.; form short and broad, costal margins abruptly dilated subbasally and roundly converging posteriorly; corial veins embrowned and membrane fuscomaculate .....**terrestris** Usinger.

Larger, over 4 mm. long.....13

13(12). Color almost entirely pale above except for usual black on head and callosities, with only occasional or ill-defined markings on scutellum, clavus, corium and membrane
.....**dallasi** White.

Scutellum black except at tip and at least with fuscous on commissure of clavus and inner veins of corium.....14

14(13). Hemelytra very pale, almost white, and characteristically marked; apical margin of corium entirely broadly black, or paler near inner and outer angles, and often with scattered fuscous marks posteriorly on vein R and on corial disc between R+M and Cu; vein Cu almost always immaculate; membrane clear.....**delectus** White.

Hemelytra clear or with a faint fulvous tinge; apical margin of corium alternated with black and ochraceous, only black at joining of vein Cu, between arms of R+M, and subapically at joining of vein Sc; vein Cu irregularly spotted with fuscous; membrane with a more or less distinct fuscous median fascia on apical half.....15

15(14). Size about 4.27 to 5.72 mm. long; anteocular part of head scarcely longer than an eye; pale areas of clavus and corium testaceous or clear hyaline.....**coenosulus** Stål.
Larger, 5.6 to 6.4 mm. in length; anteocular part of head almost one-fourth longer than an eye; pale areas of clavus and corium faintly tinged with fulvous; Hawaii .....**delectulus** Perkins.

SECTION B—THE LEEWARD ISLAND FORMS

1. Anteocular part of head two-thirds longer than an eye; body clothed above with a short, appressed, white pubescence imparting a grayish appearance; Nihoa.....
.....**longicollis** Blackburn.
Anteocular part of head never more than one-third longer than an eye; pubescence, at least on clavus and corium, more erect and hence less conspicuous unless seen from side 2

2(1). Rostrum not or scarcely passing middle coxae..... 3
Rostrum reaching well onto posterior coxae..... 7

3(2). Costal margins subparallel to about basal fifth and then abruptly, arcuately expanded; hemelytra somewhat abbreviated and distinctly, irregularly maculated with brown on clavus and corium and on membrane at least basally and at middle; upper surface of head and pronotum strongly, evenly, arcuately declivous as seen from side; fourth ventral segment of female concealed beneath third at middle..... 4
Costal margins appearing more evenly, feebly arcuate throughout, scarcely or only briefly subparallel basally; hemelytra of average length and fuscomaculate only interruptedly on apical margin of corium and occasionally on corial veins; membrane clear or scarcely infuscated; head and pronotum less strongly declivous above; fourth ventral segment in female often visible for a short distance at middle..... 5

4(3). Small, dark species, 3.39 to 3.77 mm. in length; membrane broadly brown near apical margins of coria and generally embrowned with pale veins; Nihoa.....**suffusus** Usinger.
Larger and paler, 3.58 to 4.11 mm. long; membrane only narrowly brown along apical margins of coria and infuscated along middle and apically; Necker.....
.....**chenopodii** Usinger.

5(3). Size large, female 4.83 to 5.16 mm. long; dorsum of body with some long, erect hairs best seen from side; Nihoa
.....**nihoae** Usinger.
Size smaller than indicated above; dorsum of body without conspicuous, long, erect hairs as seen from side..... 6

6(5). Head moderately, roundly convex above; body in great part pale; scutellum pale except on basal third; apical margins of coria with alternated black markings inconspicuous or wanting; Necker.....**neckerensis** Usinger.

Head only feebly elevated along middle; scutellum usually entirely black except at extreme apex; apical margins of coria each with three distinct fuscous spots; French Frigate Shoal..... **nigriscutellatus** Usinger.

7(2). Upper surface of body with relatively short and inconspicuous erect hairs as seen from side; costal margins subparallel basally and then abruptly, strongly arcuate; hemelytra abbreviated, often only slightly passing tip of abdomen in females; French Frigate Shoal..... ..... **frigatensis** Usinger.

Upper surface of body with numerous, very long, erect hairs among subappressed ones, as seen from side; costal margins of coria more or less sinuate..... 8

8(7). Very pale yellowish above, dark markings of head, pronotum, scutellum and apical margins of coria very limited in extent; posterior lobe of pronotum very sparsely punctate, punctures pale; Lisianski..... ..... **fullawayi flavus** Usinger.

Darker in coloration, with denser, black punctures on posterior lobe of pronotum; Pearl and Hermes Reef, Midway. 9

9(8). Body almost entirely brown above, yellowish at middle of head, at sides of posterior lobe of pronotum, on middle of scutellum apically, and irregularly paler elsewhere; Pearl and Hermes Reef..... **fullawayi infuscatus** Usinger.

Much paler in coloration, being predominantly yellowish-ochraceous above with usual black markings and black punctures; Pearl and Hermes Reef, Midway..... ..... **fullawayi fullawayi** Usinger.

Nysius abnormis Usinger (fig. 31).

Nysius abnormis Usinger, 1942:112, pl. 9, D.

Endemic. Molokai (type locality: Kamiloloa, 3,000 to 3,500 feet).

Hostplant: *Styphelia tameiameiae.*

The rostrum reaches the sixth abdominal sternite and is thus longer than in any other Hawaiian member of the tribe. Only the holotype is known.

Nysius blackburni White (fig. 31).

Nysius blackburni White, 1881:53. Kirkaldy, 1908:190. Usinger, 1942:99, pl. 9, I, redescription.

Nysius lichenicola variety (*b*) *brunnealis* Kirkaldy, 1910:541.

Nysius lichenicola variety (*c*) *atralis* Kirkaldy, 1910:541.

Perkins (1912:733) synonymized *lichenicola* with this species, but Usinger found them to be distinct.

Endemic. Maui, Hawaii (type locality: Kilauea, 4,000 feet).

Hostplants: *Acacia koa, Dubautia,* ferns.

Perkins (1913:cxcv) found specimens of this species "feeding in little groups of several together on the droppings of mynah birds. These birds at the time were feeding on the fruit of an imported raspberry."

Nysius chenopodii Usinger (fig. 34).
Nysius chenopodii Usinger, 1942:97.

Endemic. Necker Island (type locality).
Hostplant: *Chenopodium.*
In my opinion, this form may not be specifically distinct from *suffusus.*

Nysius coenosulus Stål (figs. 31, 33).
Nysius coenosulus Stål, 1859:243. White, 1878:369. Kirkaldy, 1910:540. Usinger, 1942:106, pl. 8, D, redescription; 140–145, pl. 10 (life history), bionomics, detailed description of nymphal stages.

Endemic. Kauai, Oahu (type locality: Honolulu), Molokai, Lanai, Maui, Hawaii.
Hostplants: *Acacia koa, Amaranthus, Argyroxiphium grayanum, Clermontia, Dodonaea, Dubautia, Eragrostis leptophylla, Erigeron* (a preferred host), *Euphorbia, Erythrina, Geranium, Heterotheca, Lythrum, Metrosideros, Myoporum, Myrsine, Pelea, Sadleria, Scaevola, Sophora, Styphelia.*
This was the first Hawaiian orsilline bug to be described. It was collected in 1852 by the expedition of the "Eugenie."
Usinger found the eggs inserted deep in the green, opened flower heads of *Erigeron*—as many as 12 to a head. There may be eight or nine generations a year, for the life cycle requires about six weeks. See Usinger for detailed studies of the immature stages.

Nysius communis Usinger (fig. 31).
Nysius communis Usinger, 1942:110, pl. 8, A.

Endemic. Kauai, Oahu, Molokai, Lanai, Maui, Hawaii (type locality: Humuula).
Hostplants: *Argyroxiphium grayanum, A. sandwicensis, A. virescens, Artemisia, Bidens* (preferred host), *Cheirodendron, Cibotium menziesii, Coprosma, Euphorbia, Lobelia gloria-montis, Metrosideros, Sadleria, Scaevola, Sophora, Styphelia.*

Nysius dallasi White (fig. 31).
Nysius dallasi White, 1878:367. Kirkaldy, 1907:152 (as *vinitor*). Perkins, 1912:732. Usinger, 1942:105, pl. 8, F, redescription.

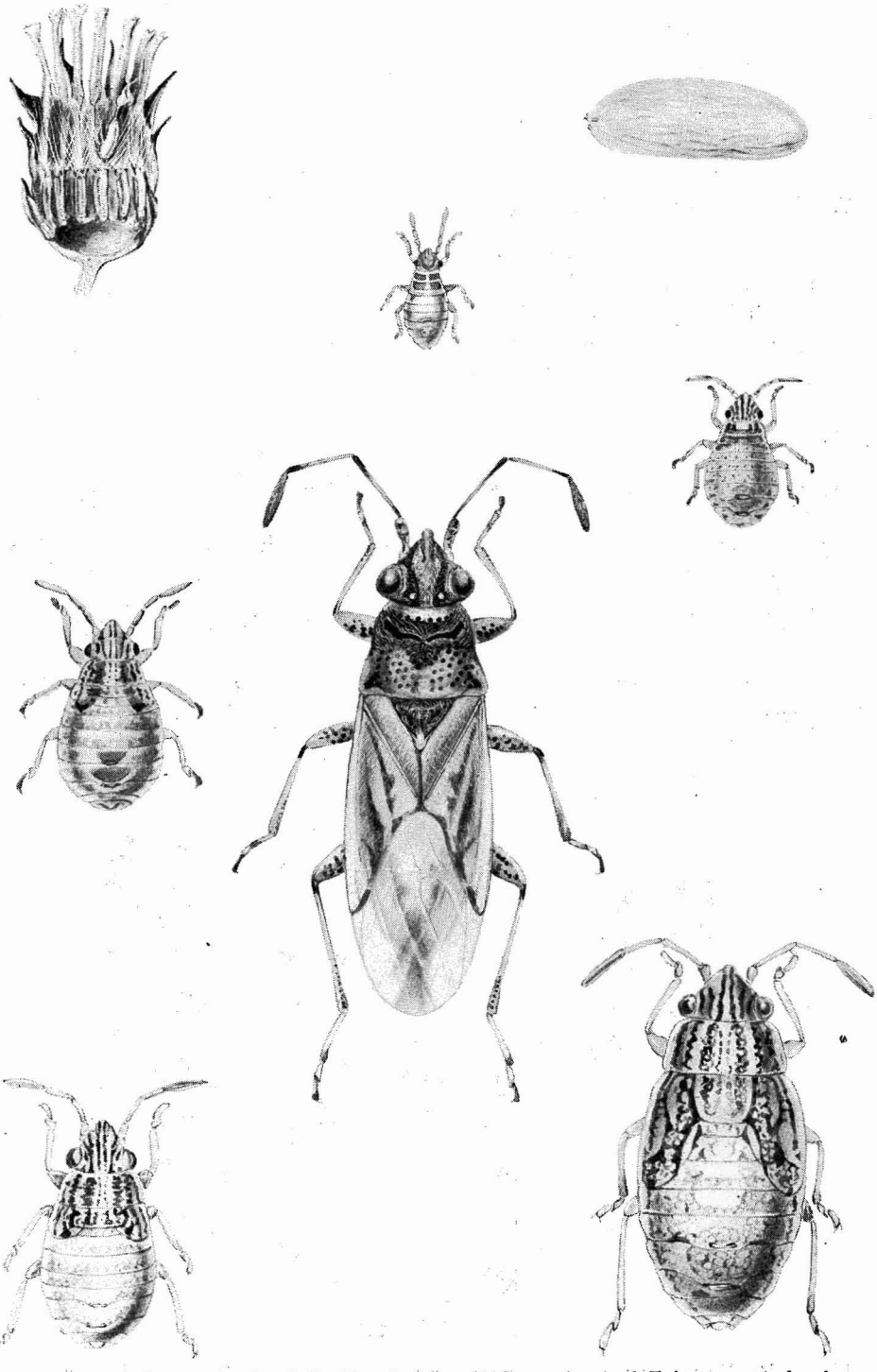

Figure 33—*Nysius coenosulus* Stål. Egg in place in flower head of *Erigeron canadensis*, egg (enlarged), the five nymphal instars and an adult male. (After Usinger.)

Endemic. Kauai, Oahu (type locality: Nuuanu Pali), Molokai, Hawaii.
Hostplant: *Portulaca.*
It has been taken at light.

Nysius delectulus Perkins (figs. 22, b; 35).
Nysius delectulus Perkins, 1912:736. Usinger, 1942:107, pl. 8, B, redescription.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Dubautia scabra.*
Although Perkins says that this species occurs on all the islands from sea level to high elevations and definitely refers to specimens from Maui and Oahu, Usinger lists it from Hawaii only and does not discuss Perkins' records.

Nysius delectus White (fig. 35).
Nysius delectus White, 1878:367. Usinger, 1942:108, redescription, illustration (pl. 8, C) and guide to literature.
Nysius kamehameha Kirkaldy, 1902:164 (type locality: Hawaii, Hualalai, 5,000 feet); synonymy by Usinger, 1942:108.

Endemic. Oahu, Molokai, Lanai, Maui, Hawaii. (No type locality given by White.)
Hostplants: *Coprosma, Dubautia, Metrosideros, Myrsine, Pelea, Phyllostegia, Stachytarpheta, Verbena bonariensis.*

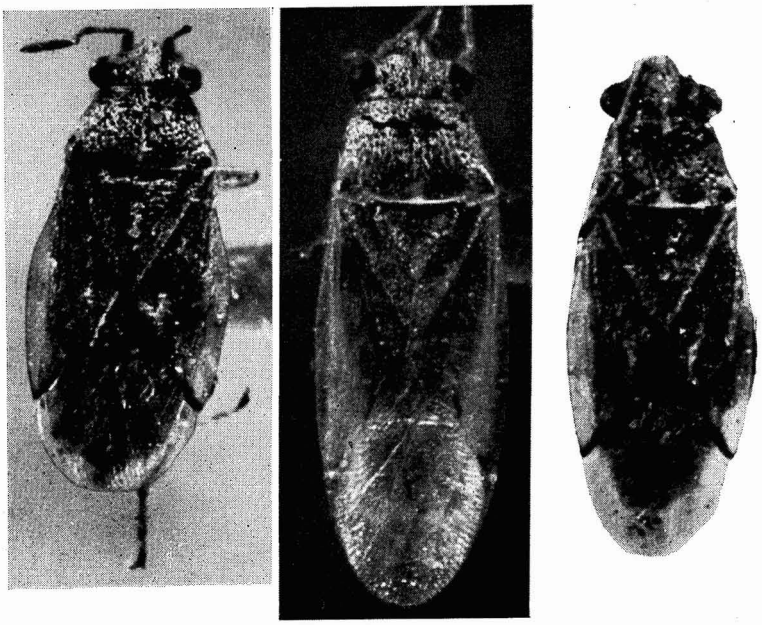

Figure 34—*Nysius chenopodii* Usinger, paratype female, left; *Nysius neckerensis* Usinger, female, center; *Nysius frigatensis* Usinger, paratype male, right.

Nysius frigatensis Usinger (fig. 34).
Nysius frigatensis Usinger, 1942:94.

Endemic. French Frigate Shoal (type locality).
This may belong to the *fullawayi* complex.

Nysius fucatus Usinger (fig. 35).
Nysius fucatus Usinger, 1942:90, pl. 9, K.

Endemic. Oahu (type locality: Kolekole Pass).
Hostplant: *Bidens.*

Nysius fullawayi fullawayi Usinger (fig. 35).
Nysius fullawayi fullawayi Usinger, 1942:93, pl. 9, E.

Endemic. Pearl and Hermes Reef (type locality), Midway (?).
The hemelytra on this form are nearly immaculate.

Nysius fullawayi infuscatus Usinger (fig. 35).
Nysius fullawayi fullawayi variety *infuscatus* Usinger, 1942:94, pl. 9, G.

Endemic. Pearl and Hermes Reef (type locality).
The hemelytra on this variety are maculate on both clavus and corium.

Nysius fullawayi flavus Usinger.
Nysius fullawayi subspecies *flavus* Usinger, 1942:94.

Endemic. Lisianski Island (type locality: northeast corner of the island).
Hostplant: bunch grass (?).
This subspecies is pale and flavescent instead of ochraceous.

Nysius lichenicola Kirkaldy (fig. 36).
Nysius lichenicola Kirkaldy, 1910:540. Usinger, 1942:98, redescription.

Endemic. Maui (type locality: Mount Haleakala, 7,000 feet), Hawaii.
Hostplants: *Acacia koa,* dandelion, *Dubautia, Eragrostis* (preferred host), *Geranium, Metrosideros, Sophora, Styphelia, Vaccinium.*

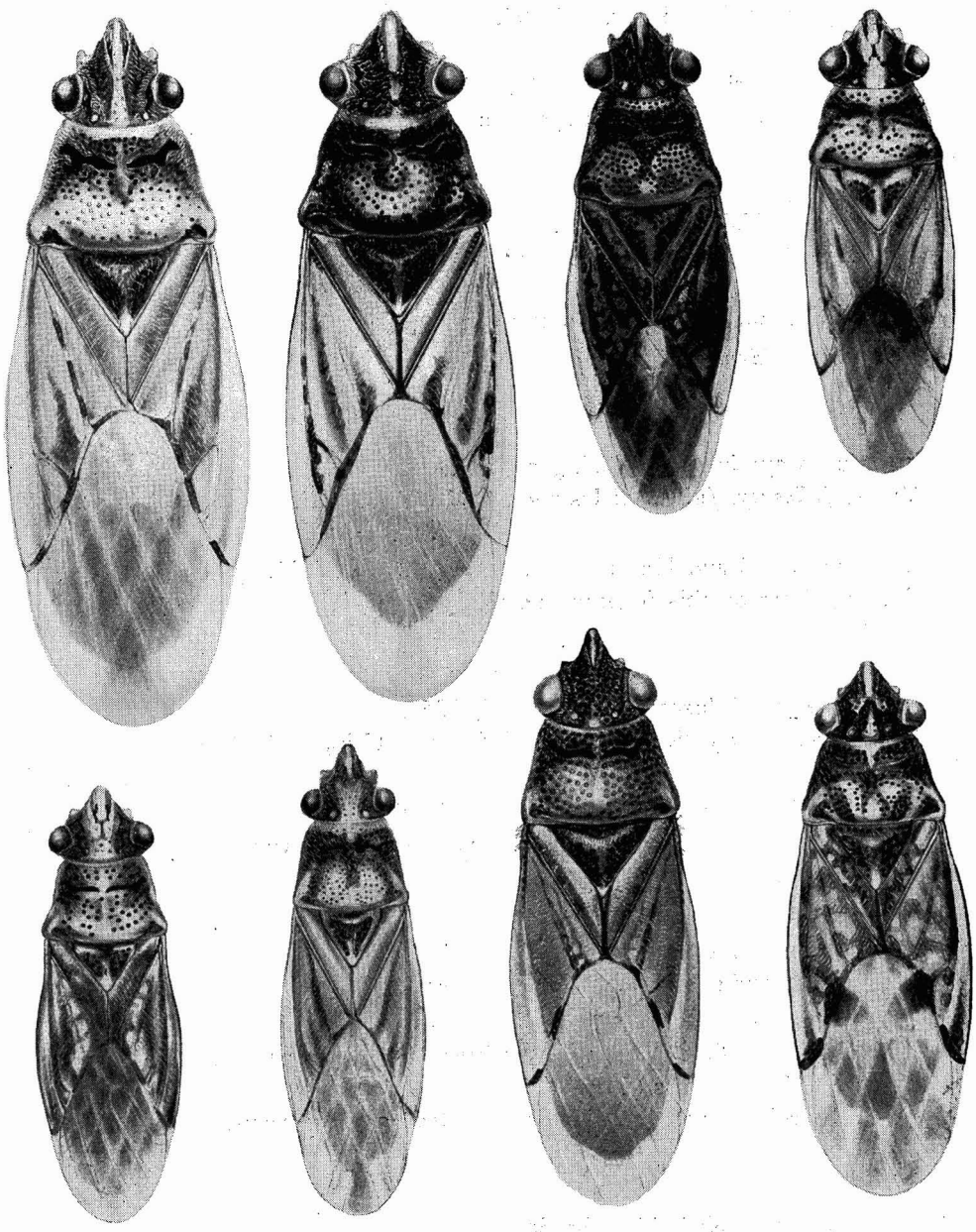

Figure 35—*Nysius* species. Top row, left to right: *N. delectulus* Perkins, allotype female; *N. delectus* White, female; *N. fucatus* Usinger, holotype male; *N. fullawayi fullawayi* Usinger, male. Bottom row, left to right: *N. fullawayi infuscatus* Usinger, holotype male; *N. longicollis* Blackburn, male; *N. mixtus* Usinger, female; *N. nemorivagus* White, female. (Rearranged from Usinger's original Abernathy drawings.)

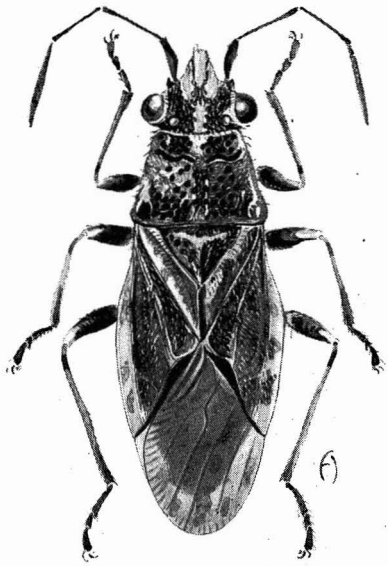

Figure 36—*Nysius lichenicola* Kirkaldy. (Abernathy drawing.)

Usinger (1942:99) stated that "The nearest extra-Hawaiian relative of *N. lichenicola* appears to be *N. huttoni* White from New Zealand. . . ." I do not believe that it has been shown that this species is a relative of the New Zealand species. It would be more appropriate to say that of the known extra-Hawaiian species, *N. lichenicola* resembles *N. huttoni* more than any other species.

Nysius longicollis Blackburn (fig. 35).

Nysius longicollis Blackburn, 1888:344. Perkins, 1912:733, redescription of the holotype. Usinger, 1942:89, pl. 9, C, redescription.

Endemic. Kauai, Oahu (no further type locality given by Blackburn), Maui, Hawaii, Nihoa.

Hostplant: *Eragrostis.*

Nysius mixtus Usinger (fig. 35).

Nysius mixtus Usinger, 1942:110, pl. 8, E.

Endemic. Kauai (type locality: Kalalau).

Hostplants: *Dubautia, Styphelia.*

Nysius neckerensis Usinger (fig. 34).

Nysius neckerensis Usinger, 1942:104.

Endemic. Necker Island (type locality).

Hostplant: *Chenopodium.*

Nysius nemorivagus White (fig. 35).

Nysius nemorivagus White, 1881:54. Perkins, 1912:734. Usinger, 1942:101, pl. 9, F, redescription.

Endemic. Kauai, Oahu (?), Molokai, Lanai, Maui, Hawaii (type series from Mauna Kea, Hawaii, and Haleakala, Maui, 5,000 to 6,000 feet).

Hostplants: amaranth, Chinese cabbage, *Clermontia,* cucumber, *Dubautia, Lythrum,* potato (reported to have caused severe withering), *Solanum nodiflorum, Sophora,* hard-skinned squash.

Nysius nigriscutellatus Usinger (fig. 37).

Nysius nigriscutellatus Usinger, 1942:102, pl. 8, G.

Endemic. Kauai, Oahu, Molokai, Lanai (?), Maui, Kahoolawe, Hawaii (type locality: Humuula, 6,000 feet), French Frigate Shoal.

Hostplants: amaranth, *Argyroxiphium grayanum, Artemisia, Cheirodendron gaudichaudi,* dandelion, *Dubautia, Eragrostis,* mango ("feeding on the fruits"), *Osmanthus, Portulaca, Sida,* spinach, *Styphelia.*

This is the most widespread of all of the endemic Hawaiian Heteroptera. It occurs from the beaches to over 10,000 feet in the mountains and is spread throughout most of the Hawaiian Archipelago.

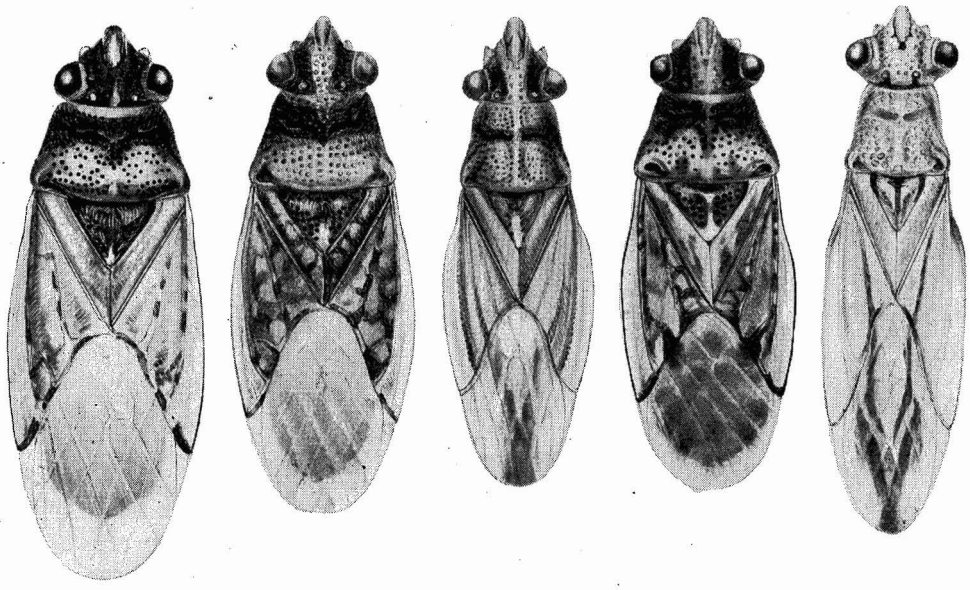

Figure 37—Species of Orsillini. Left to right: *Nysius nigriscutellatus* Usinger, female; *Nysius rubescens* White, female; *Nysius sublittoralis* Perkins, male; *Nysius terrestris* Usinger, female; *Nesomartis psammophila* Kirkaldy, female. (Rearranged from Usinger's original Abernathy drawings.)

Nysius nihoae Usinger.
Nysius nihoae Usinger, 1942:103.

Endemic. Nihoa Island (type locality).
Is this form more than a geographical segregate of *nigriscutellatus?*

Nysius rubescens White (figs. 21, 37).
Nysius rubescens White, 1881:55. Perkins, 1912:732. Usinger, 1942:91, pl. 9, H, redescription.

Endemic. Hawaii (type locality: Kilauea, 4,000 feet).
Hostplants: *Vaccinium* ("ohelo" berry), ferns.
The last nymphal instar has been described and figured by Usinger, p. 152, pl. 12, F.

Nysius sublittoralis Perkins (fig. 37).
Nysius sublittoralis Perkins, 1912:737. Usinger, 1942:88, pl. 9, B, redescription.

Endemic. Oahu (type locality: Waianae coast), Maui, Hawaii.
Hostplant: *Nicotiana tabacum* (native hosts unknown).

Nysius suffusus Usinger.
Nysius suffusus Usinger, 1942:96.

Endemic. Nihoa Island (type locality).
Hostplant: "bunch grass."

Nysius terrestris Usinger (fig. 37).
Nysius terrestris Usinger, 1942:95, pl. 9, J.

Endemic. Kauai, Oahu (type locality: Manana Islet), Molokai, Maui, Kahoolawe, Hawaii.
Hostplants: *Argyroxiphium,* Chinese cabbage, *Dubautia, Geranium, Hibiscus, Portulaca* (preferred host), *Sida, Sophora, Styphelia.*
The following observations are Usinger's (1942:152):

> This species occurs in great numbers in company with *Nysius dallasi* on *Portulaca oleracea.* I found the two species in great abundance in the dense growth of *Portulaca* which completely carpets large areas of ground on Manana Island [Oahu]. Thirty-seven copulating pairs were counted, and no crossing of the two species was observed.

Near the beach at Mapulehu, Molokai, a similar situation was observed, thousands of bugs running about on the plants and on the ground beneath. Nymphs from the first instar (pink or red in color) to large last instar crowded and tumbled about in the dry dirt.... On August 17, 1936, several perfectly typical *Nysius* eggs were found glued to the surface of the glass vial with dirt particles adhering to them, forming a protecting or concealing cover. These eggs hatched on August 23, giving an incubation period of six days.

This species was accidentally introduced to Johnston Island during the war.

Genus **NESOMARTIS** Kirkaldy, 1907:245

Kirkaldy, 1910:535.
Usinger, 1942:113, redescription.

This endemic genus is represented by one of the most distinct members of our Orsillini. Kirkaldy originally placed it in the subfamily Cyminae. Its long, slender, hairy body, its relatively narrow pronotum and correspondingly broad head, whose greatest breadth across the eyes is greater than the base of the pronotum, will serve to distinguish it easily from all the other Hawaiian members of the tribe. The elevated parts of the bucculae extend well behind the fore edges of the antenniferous tubercles, and the hind margins of the metapleura are concave. A single species is known.

Nesomartis psammophila Kirkaldy (fig. 37).

Nesomartis psammophila Kirkaldy, 1907:245. Usinger, 1942:113, pl. 9, A, redescription. Genotype.

Endemic. Kauai, Oahu (type locality: not stated more definitely by Kirkaldy), Maui, Hawaii.

Hostplants: *Eragrostis* (bunch grass, preferred host), *Sida, Sophora.*

"*Nesomartis psammophila* frequents sandy places, on or near the coast, living on low grass, or on the ground beneath, with its nymphs. In the larger of these the head is not produced far beyond the sides of the pronotum, as in the adult, but is of ordinary form. The youngest nymphs are remarkable for their shining black head and thorax, with white mediodorsal line." (Perkins, 1913:cxcv.)

Tribe METRARGINI (Kirkaldy) Usinger, 1942:15

Metrarginae Kirkaldy, 1902:164.
Hutchinson, 1934:134, brief note.

This group is endemic to the Hawaiian Islands. It is closely related to, if truly separable from, the Orsillini, and it evidently is an offshoot of some old Hawaiian *Nysius*-like bug. Usinger (1942:16) says that "*Metrarga* is structurally very

similar to the Orsillini but is very different in appearance, being much broader and flatter, the antenniferous tubercles sharply produced as stout spines, the posterior margin of sixth tergite in the male subtruncate, the coxal flanges punctate, and corial vein Sc distinct throughout its length and evidently complete, joining apical margin of corium near corial apex." The less divergent species might appear to be only generically distinct from *Nysius,* and the relationship is obvious.

The three divergent groups of species thus far discovered were given subgeneric rank by Kirkaldy in 1908, after he had considered them species in 1902. Usinger tells me that they are entitled to generic standing. I have followed his decision, although I feel that I might not consider them any more than distinct species of a single genus, but I am not a specialist in the Heteroptera.

The winged species are often notably gregarious, a dozen to scores congregating together at the base of the leaves of a single plant of *Freycinetia.* The nymphs occur in the same situation, sometimes mixed with the adults. These winged species may also be found on the ground amongst dead leaves or fragments of fern fronds, while the flightless *M. villosa* seems to have taken entirely to a terrestrial life, and perhaps became flightless in accordance with these habits. It is remarkable that amongst large flocks of one of the winged species (e.g. *contracta*) one or two examples of another species (*nuda*) are sometimes found, so that the flocks are mixed. The odour of the species is disgusting, when a colony is disturbed, and taints the surrounding air. While the representatives of *M. nuda* that are found on Hawaii, Oahu, and Maui are very similar, it is noteworthy that the Molokai form, although of precisely similar habits, is more distinct in appearance superficially. (Perkins, 1913:cxciv.)

Perkins (1913:cxcv) notes that certain species of *Nysius* (*sensu lato* ?) "... are at times met with living gregariously at the base of the leaves of *Freycinetia* like the *Metrargae.*"

I have never met with any species of the group in such numbers as Perkins describes, nor have I seen any long series of specimens collected since Perkins' time. There appears to be no doubt that these insects have become much rarer in the last quarter of a century.

Key to the Genera of Metrargini

1. Pronotum with each antero-lateral angle produced as a prominent, acutely pointed tooth (fig. 38) ..... **Metrarga** White.
   Antero-lateral pronotal angles rounded (fig. 39, middle and right) 2
2. Membrane of hemelytra not reduced, much longer than length of claval suture; ocelli well developed (fig. 39, right) ..... **Nesoclimacias** (Kirkaldy).
   Membrane of hemelytra greatly reduced, much shorter than claval suture; ocelli usually obsolete (fig. 39, middle) ..... **Nesocryptias** (Kirkaldy).

Genus **METRARGA** White, 1878:370

This group has the wing membrane normal, not abbreviated, and the fore corners of the pronotum are each produced into a sharp spine. There are several new forms awaiting description.

KEY TO THE FORMS OF METRARGA

1. Distance across head to outer edges of eyes slightly greater than distance between apices of antero-lateral pronotal spines... ..... **obscura** Blackburn.
   Distance between apices of antero-lateral pronotal spines greater than breadth of head to outer edges of eyes..... 2
2. Explanate corial margins distinctly and conspicuously spotted ..... **nuda nuda** White.
   Explanate corial margins obscurely and indistinctly maculate ..... **nuda mauiensis** Kirkaldy.

Figure 38—*Metrarga obscura* Blackburn.

Metrarga nuda nuda White (fig. 39).

Metrarga nuda White, 1878:371. Kirkaldy, 1902:165, pl. 5, figs. 41–42. Genotype.

Endemic. Oahu, Maui, Hawaii. (No type locality given by White.)

Kirkaldy (1907:153) described the nymph as follows: "Antennal tubercles acute and prominent; eyes not touching pronotum. Pronotum about .3 times as wide as long, the lateral margins laminate and minutely crenulate. Abdomen laterally explanate, odoriferous orifices elongate and very short, on fifth and sixth tergites."

Habit: found under dead bark and in cavities in dead branches of *Pipturus, Metrosideros* and *Cibotium.*

Metrarga nuda mauiensis Kirkaldy.
Metrarga nuda variety *mauiensis* Kirkaldy, 1908:188.

Endemic. Maui (type locality not specifically given).

Metrarga obscura Blackburn (fig. 38).
Metrarga obscura Blackburn, 1888:347.

Endemic. Hawaii (type locality: Mauna Loa, 4,000 feet).
Hostplant: *Metrosideros.*

Genus **NESOCLIMACIAS** (Kirkaldy)

Subgenus *Nesoclimacias* Kirkaldy, 1908:189.

This group resembles *Nesocryptias,* but the hemelytra are fully formed, and the hind wings are developed for flight. The antero-lateral corners of the pronotum are rounded. In the genotype, *contracta,* the first segment of the rostrum reaches the front edge of the fore coxae. However, in *lanaiensis* it is shorter, and this character can hardly be used in a supraspecific sense as Kirkaldy used it in 1908.
A new species from Molokai is in our collections.

Key to the Forms of Nesoclimacias

1. Rostrum not extending beyond middle of fourth abdominal ventrite; Lanai ..... **lanaiensis** (Kirkaldy).
   Rostrum reaching middle of fourth ventrite or beyond..... 2
2. Pronotum and hemelytra mostly yellowish-brown..... ..... **contracta contracta** (Blackburn).
   Pronotum and hemelytra mostly dark brown to piceous..... ..... **contracta picea** (Kirkaldy).

Nesoclimacias contracta contracta (Blackburn) (fig. 39).
Metrarga contracta Blackburn, 1888:347.
Metrarga (*Nesoclimacias*) *contracta* (Blackburn) Kirkaldy, 1908:189. Genotype of *Nesoclimacias.*

Endemic. Oahu (type locality: Konahuanui, 2,500 feet).
Habit: it has been found in decaying vegetation and at the leaf bases of *Freycinetia.*

Nesoclimacias contracta picea Kirkaldy.

Nesoclimacias contracta variety *picea* Kirkaldy, 1908:188.

Endemic. Oahu (type locality: Koolau Mountains).

Habit: Kirkaldy (1908:188) reported finding it in ground litter and on *Freycinetia.*

Nesoclimacias lanaiensis (Kirkaldy).

Metrarga (*Nesoclimacias*) *lanaiensis* Kirkaldy, 1908:189; 1902:166–167, in part, pl. 5, fig. 43 a.

Endemic. Lanai (no definite type locality given, but taken at 2,000 feet or at Halepaakai).

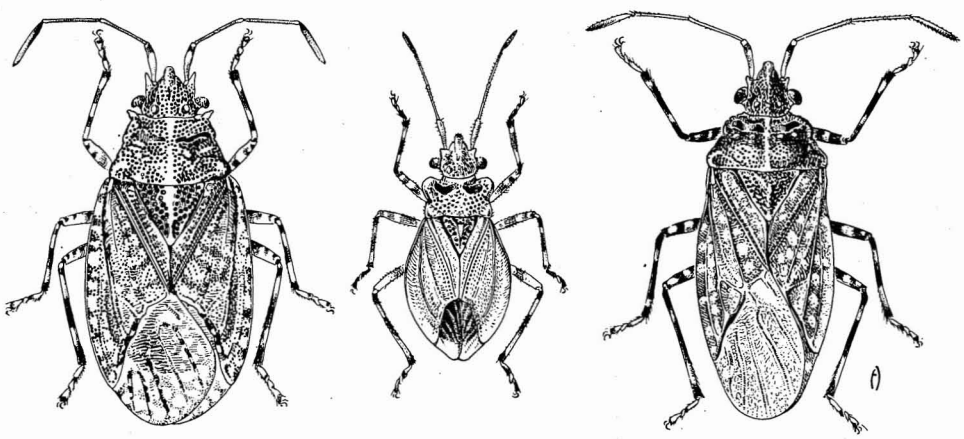

Figure 39—*Metrarga nuda nuda* White, left. *Nesocryptias villosa* (White), middle. *Nesoclimacias contracta* (Blackburn), right. (Drawn to same scale by Abernathy.)

Genus **NESOCRYPTIAS** (Kirkaldy)

Subgenus *Nesocryptias* Kirkaldy, 1908:189.

The species assigned to this genus are essentially brachypterous, flightless derivatives of *Nesoclimacias.* The hemelytra have the membrane greatly reduced so that it reaches only slightly behind the apices of the coria—its extreme length is less than the length of a clavus, whereas it is much longer than a clavus in *Nesoclimacias.* The hind wings are greatly reduced to squamiform appendages shorter

than the scutellum. The antero-lateral corners of the pronotum are rounded, and, on the specimens examined, the rostrum passes the metacoxae. Most of the specimens examined by me have their ocelli obsolete.

A new Oahu species has been seen.

Nesocryptias villosa (White) (fig. 39).

Metrarga villosa White, 1878:371. Kirkaldy, 1902:167, pl. 5, fig. 44.
Metrarga (*Nesocryptias*) *villosa* (White) Kirkaldy, 1908:189.

Endemic. Kauai, Oahu (type locality: "Not rare among rotten leaves, etc., at the foot of a precipice on the mountains five or six miles from Honolulu.").

Hostplants: *Byronia, Freycinetia, Myoporum,* and found among decaying vegetation and damp ground litter in the forests.

Subfamily GEOCORINAE (Stål) Distant, 1882

Geocorida Stål, 1862.

The Big-eyed Bugs

These bugs are easy to distinguish from the other Hawaiian Heteroptera because of their large, unusual eyes (see fig. 40). They somewhat resemble certain Orsillini, but a glance at their heads will distinguish them. The salient characters are well expressed by the illustrations.

This subfamily is not represented in the native fauna of Hawaii, but the high islands to the south and southwest have endemic species. The genus *Germalus* is well represented as far east as the Marquesas Islands, where it has developed several distinct species. Had that genus reached Hawaii at an early date, it is probable that it might have proliferated as did the *Nysius* group. *Germalus,* because of its habits and facies, recalls *Nysius* to me whenever I collect it in the south Pacific.

Genus **GEOCORIS** Fallen, 1814

Usinger, 1936:213, redescription.

The two species found in Hawaii are adventitious.

"Almost without exception the early references condemn the bugs as destructive, often simply on superficial evidence of their occurrence on a given plant. All recent records throughout the world, however, report them as predaceous on eggs,

nymphs, or even adults of mites, aphids, plant bugs, leafhoppers, etc." (Usinger, 1936:214.) York (1944:25) has reported on his studies of the habits of our two species in California. He found that they fed upon the beet leafhopper (*Eutettix tenellus* [Baker]) and its eggs. The *Geocoris* cannot live upon insects or plants alone, for, although they feed upon eggs, nymphs and adults of the leafhopper, they need extra water which can only be supplied from the plants. York (1944) concluded "that it would be practicable to experiment with these predators as a factor of natural control." He also summarized previous work as follows:

Chamberlin and Tenhet (1923) reported *Geocoris punctipes* (Say) as feeding on flea beetles. Gilmore (1936) observed the same species feeding on eggs of the tobacco horn-worm. Knowlton (1937) fed *Geocoris decoratus* (Uhler) on beet leafhoppers, and showed them to be capable of reducing leafhopper populations. Ewing and McGarr (unpublished report 1931) and King and Cook (1932), however, reported that *Geocoris punctipes* (Say) fed on cotton plants in cage experiments and produced positive reactions internally but no external swellings or damage. Lockwood (1933) has reported *Geocoris* spp. and other plant bugs as destructive to cotton in California.

Perhaps these latter reports confused the moisture-getting habit with destructive feeding.

Key to the Geocoris Found in Hawaii

1. Head and pronotum distinctly hirsute; head minutely granulate, predominantly black, without an oblique sulcus arising from near base of tylus..... **pallens** Stål.
2. Head and pronotum appearing bare; head smooth and polished, shiny, predominantly yellow marked with black, with a distinct sulcus arising from near base of tylus and directed obliquely outward and forward toward inner interior edges of each eye..... **punctipes** (Say).

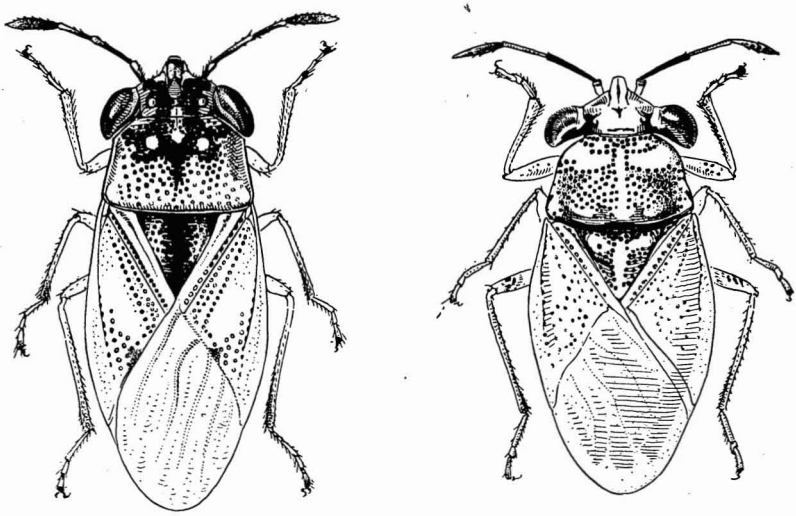

Figure 40—*Geocoris pallens* Stål, left. *Geocoris punctipes* (Say), right. (Drawings by Abernathy; *G. pallens* drawn to one-fifth larger scale than *G. punctipes.*)

Geocoris pallens Stål (fig. 40).
Geocoris pallens Stål, 1874:236.

Kauai, Oahu, Hawaii.

Immigrant. A common species in western United States. First reported in the Hawaiian Islands by Usinger (1936:214) from specimens collected in 1935.

Hostplants: bunch grass, *Ipomoea, Sophora, Sporobolus, Vitex.*

This species is smaller than *punctipes,* "head black, finely granular and beset with a short, sparse, white pubescence. Longitudinal and transverse sulci, except on tylus, obscure or wanting. Antero-lateral margins of pronotum distinctly angulated. Head, in great part, pronotum anteriorly and extending posteriorly behind the callosities, and scutellum at base and longitudinally at middle, black. Hemelytra opaque. Length, 3.5 mm." (Usinger, 1936:214.)

Geocoris punctipes (Say) (fig. 40).
Salda bullata variety *punctipes* Say, 1832:19.

Kauai, Oahu, Molokai.

Immigrant. Widespread in southwestern United States and Mexico. First found in the Hawaiian Islands by Swezey in 1935 at Ewa Coral Plain, Oahu.

Hostplants: Australian salt bush, *Cynodon dactylon* (Bermuda grass), *Ilex sandwicensis, Portulaca.*

The nymphs are greenish-gray or whitish with black markings.

"A large, polished species rather uniformly light in color. Head in great part ochraceous or with fuscous to black markings, not at all granulous, with a fine longitudinal sulcus extending from sulcation of tylus onto vertex. A distinct, transverse arcuate sulcus behind the tylus, not attaining eyes. Antero-lateral angles of pronotum rounded. Basal angles of scutellum with distinct, pale calloused areas. Hemelytra hyaline. Length 4–4.5 mm." (Usinger, 1936:213.)

Subfamily CYMINAE (Stål) Uhler, 1877

Cymida Stål, 1862.

The members of this subfamily are perhaps most readily distinguished from the other Hawaiian Lygaeidae because they have the clavi and coria conspicuously and extensively punctate, but the eyes are not enlarged as in the Geocorinae, and they have a different abdominal structure from the Rhyparochrominae, some of which have punctate hemelytra.

The genus *Nesocymus* from the Marquesas may be related to the Hawaiian generic complex.

KEY TO THE GENERA OF HAWAIIAN CYMINAE

1. Rostrum reaching, or extending only a short distance behind, fore coxae ..... **Pseudocymus** Van Duzee.
   Rostrum extending distinctly behind fore coxae, nearly to or to mesocoxae 2
2. Distance between ocelli approximately equal to distance between an ocellus and an eye; pronotum with a distinct, entire, narrow, transverse, dorsal impression at about middle..... ..... **Nesocymus** Kirkaldy.
   Distance between ocelli obviously greater than distance between an ocellus and an eye; pronotum without such an impression ..... **Sephora** Kirkaldy.

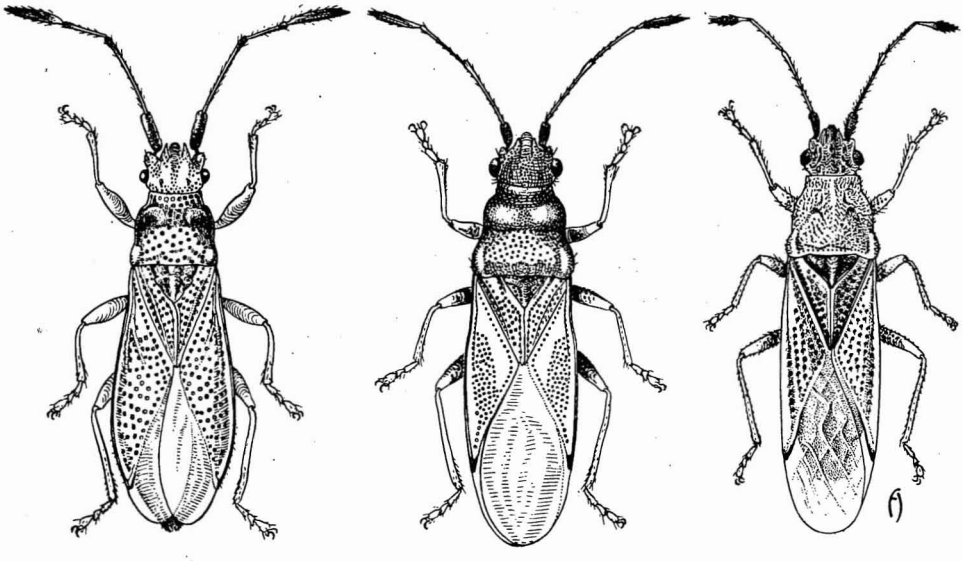

Figure 41—*Pseudocymus giffardi* Van Duzee, left. *Nesocymus calvus* (White), middle. *Sephora criniger* (White), right. (All drawn to same scale by Abernathy.)

Genus **PSEUDOCYMUS** Van Duzee, 1936:223

This monotypic, endemic genus is obviously allied to the other two Hawaiian genera of Cyminae. Its short rostrum, veinless, transparent hemelytral membrane and comparatively bare, shiny dorsum are some of the characters which may serve to distinguish it.

Pseudocymus giffardi Van Duzee (fig. 41).
Pseudocymus giffardi Van Duzee, 1936:224. Genotype.

Endemic. Oahu (type locality: Nuuanu Pali).
Hostplant: *Eragrostis*.

Genus **NESOCYMUS** Kirkaldy, 1907:245

In addition to the differential characters mentioned in the key, the only described species of this endemic genus may be distinguished by its striking color pattern. The wing membrane bears a conspicuous, broad, median, dark vitta; the anterior lobe of the pronotum is grayish-velutinous or pruinose, and this pale color extends back on the sides and at the middle to form a zigzag pattern along the anterior part of the brown, posterior, pronotal lobe. Some of the membranal veins are faintly indicated.

I have seen a series of a distinct new species from the island of Hawaii.

Nesocymus calvus (White) (fig. 41).

Cymus calvus White, 1881:56.

Sephora calvus (White) Kirkaldy, 1902:162.

Nesocymus calvus (White) Kirkaldy, 1907:245. Genotype.

Endemic. Oahu (type locality: "Under stones in the mountains near Honolulu, at an elevation of about 2000 feet.").

Hostplants: sedges, *Carex, Cyperus, Eragrostis, Pipturus.*

Dr. Swezey took a series of this species from a native sedge in the mountains above Kahana, Oahu. The specimens were on the flower clusters. The last two hostplants mentioned above probably are not hosts, for the bug is a sedge-eating species. Perkins (1913:cxciv) noted that it "lives on sedges, nymphs and adults occurring together, often in great numbers."

Genus **SEPHORA** Kirkaldy, 1902:161

There is only one species described in this endemic genus. The veins in the hemelytra are distinct and the setae on the entire dorsum are longer and obviously more conspicuous than on the representatives of the other two associated genera. The genotype is a yellowish insect with a grayish cast.

Sephora criniger (White) (fig. 41).

Cymus criniger White, 1881:57.

Sephora criniger (White) Kirkaldy, 1902:161, pl. 5, fig. 45. Genotype.

Endemic. Molokai, Lanai, Maui (type locality: Mount Haleakala, 5,000 feet, under stones).

Hostplants: *Coprosma, Gouldia, Sadleria, Scaevola, Straussia,* fern fronds.

Subfamily RHYPAROCHROMINAE (Stål) Van Duzee, 1917

Rhyparochromida Stål, 1862.

The best diagnostic feature of this subfamily is the shape and course of the hind margin of the third abdominal ventrite as mentioned in the key to the subfamilies. The hind margin may be somewhat obscure laterad, but it does not extend directly to the side margin and it usually curves distinctly cephalad. Although not all the species found in Hawaii have spined femora, the only Hawaiian representatives of the family with armed femora do belong here (*Pachybrachius* and *Tempyra*).

This is the largest subfamily of the Lygaeidae, yet it has no endemic representatives in our insular fauna.

Key to the Genera of Rhyparochrominae Found in Hawaii

1. Fore femora with conspicuous stout spines beneath..... 2
   Fore femora without spines..... 3

2(1). Pronotum with a strongly developed, conspicuous collar, lateral margins not margined; ocelli conspicuous..... .....**Pachybrachius** Hahn.
   Pronotum without a collar, lateral margins distinctly margined, narrowly explanate; ocelli obsolete.....**Tempyra** Stål.

3(1). Underside of head conspicuously grooved almost to prothorax, the conspicuously elevated sides of groove extending nearly to base; prosternum distinctly grooved in middle in front of coxae for reception of rostrum which does not reach fore coxae.....**Reclada** White.
   Rostral groove not extending much behind fore edges of eyes; prosternum not longitudinally grooved; rostrum reaching beyond fore coxae.....**Clerada** Signoret.

Genus **PACHYBRACHIUS** Hahn, 1826

Orthaea Dallas, 1852. See China, 1943.
Orthoea, of some authors.

The armed fore femora will separate this genus from the other Hawaiian members of the subfamily, excepting *Tempyra,* but that genus is distinct from *Pachybrachius* because it lacks a well-developed pronotal collar, it does not have the pronotum strongly and sharply divided into two large lobes, its pronotum is explanate on the sides instead of being rounded off and not margined—in addition to numerous other differences.

Both species of the genus are attracted to light, often in great numbers, especially on calm, damp nights.

Although this is a large and difficult group, the two species found in Hawaii are distinct and easily recognized.

KEY TO THE SPECIES OF PACHYBRACHIUS FOUND IN HAWAII

1. Pronotum, scutellum, corium and clavus with long, fine, conspicuous erect hair.....**nigriceps** (Dallas).
2. Pronotum, scutellum, corium and clavus not at all "hairy," with short, appressed, sparse, inconspicuous setae..**vincta** (Say).

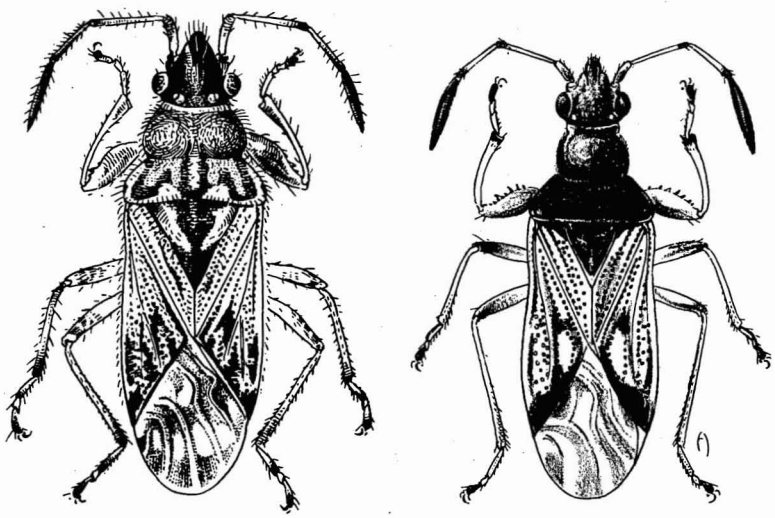

Figure 42—*Pachybrachius nigriceps* (Dallas), left. *Pachybrachius vincta* (Say), right. (Drawings by Abernathy. *P. vincta* drawn to one-sixth larger scale.)

Pachybrachius nigriceps (Dallas) (fig. 42).

Rhyparochromus nigriceps Dallas, 1852:577.

Pamera nigriceps (Dallas) Stål, 1874:152. White, 1878:369.

Orthaea nigriceps (Dallas), of authors.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii (type locality: "Sandwich Islands").

Immigrant. Widespread in the Pacific, but described from our islands.

Hostplants: *Coprosma, Gouldia,* grasses, *Lythrum, Sophora.*

This species may occasionally occur in numbers on truck crops, especially during dry weather when its lowland hostplants dry up. It has been reported "damaging" certain crops and has been confused with *Nysius* by some local workers.

Myers (1926:482–483) describes the early stages and gives notes on the insect in New Zealand.

Pachybrachius vincta (Say) (fig. 42).

Pamera vincta Say, 1832:16.

Orthaea pacifica Kirkaldy, 1907:150, not Stål.

Orthaea periplanios Kirkaldy, 1907:246.

Orthaea vincta (Say), of authors.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Almost tropicopolitan; probably a western Pacific species. First found in the Hawaiian Islands at Waikiki, Oahu, in 1900 (although Kirkaldy, 1907:150, says it was 1902 or 1903).

Hostplants: *Clermontia, Cynodon dactylon* (preferred host ?), *Sophora, Vaccinium* ("ohelo").

The brachypterous individuals look like a different species. They are narrower and have the wing membrane so reduced that the genital capsule and adjacent abdominal tergites are exposed. Kirkaldy (1907:150–151) described the last nymphal instar in detail.

Genus **TEMPYRA** Stål, 1874

Epelytes Kirkaldy, 1910:119.

Among the Hawaiian members of the subfamily, this genus has the sides of the pronotum explanate in common with *Clerada* and *Reclada,* but it is easily distinguished from those genera because of its multispinose fore femora alone, not to mention the many other differences.

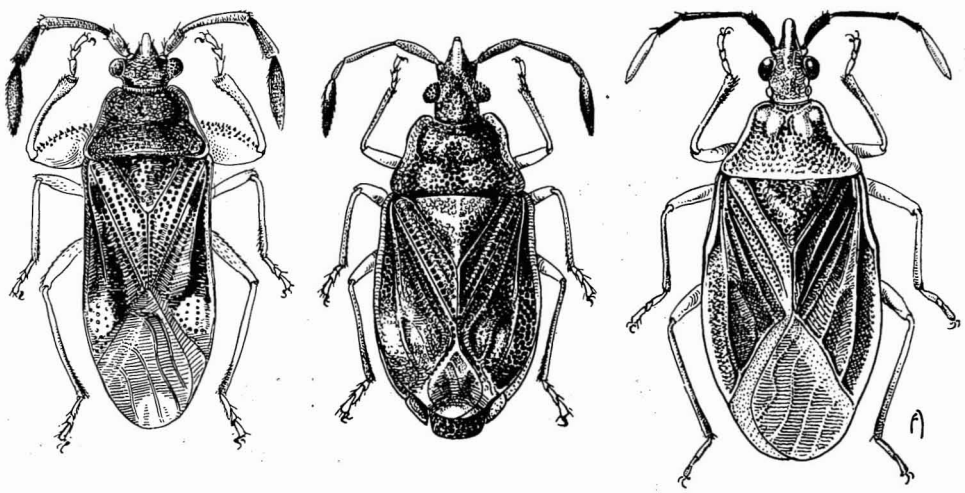

Figure 43—*Tempyra biguttula* Stål, left; *Reclada moesta* White, middle (drawn to same scale); *Clerada apicicornis* Signoret, right, drawn to twelve-sevenths the scale of the other two drawings. (Drawn by Abernathy.)

Tempyra biguttula Stål (fig. 43).

Tempyra biguttula Stål, 1874:157. Genotype.

Epelytes draptes Kirkaldy, 1910:119. (Genotype of *Epelytes;* described from Koloa, Kauai.)

Kauai, Oahu.

Immigrant. Known also from North America; originally described from Texas. Found by Swezey on Kauai in 1908, and a specimen in Perkins' collection bears a label reading "a late introduction, Honolulu, 1908."

Hostplant: *Canavalia.*

It is attracted to light, and most of the specimens seen were taken at light. The type of *draptes,* which is in the collection of the Experiment Station, Hawaiian Sugar Planters' Association, was found in a bean pod. The pale spot on each corium is distinctive; see the illustration. Nothing appears to be known of its habits. Is it predaceous?

Genus **RECLADA** White, 1878:370

This genus is allied to *Clerada* and shares with it the remarkably situated ocelli. These organs are placed on the sides of the upper surface of the head on or slightly behind a line drawn between the hind margins of the eyes. The hemelytral membrane does not exceed, or hardly exceeds, the tip of the abdomen, and the entire insect is dull and punctate.

Reclada moesta White (fig. 43).

Reclada moesta White, 1878:370. Genotype.

Clerada minuta China, 1924:435, fig. 1, C. Synonymy by China, 1930:127.

Kauai, Oahu (exact type locality not known), Nihoa.

Immigrant. Probably widespread, but little known, from the Mascarene subregion to Polynesia.

Hostplants: bunch grass, *Euphorbia, Pritchardia.*

It may be predaceous.

Genus **CLERADA** Signoret, 1863:J–28

This genus is allied to *Reclada* but can be distinguished by not having the underside of its head and prosternum grooved as in *Reclada* and by having its rostrum extending beyond the fore coxae. Our species is about twice as large as the representative of *Reclada* (about 7 or 8 mm. as compared to about 3 or 4 mm.).

The hemelytral membrane reaches hardly beyond the abdomen.

Clerada apicicornis Signoret (fig. 43).

Clerada apicicornis Signoret, 1863:J–28, pl. 20, fig. 8.

Kauai, Oahu, Hawaii.

Immigrant. Tropicopolitan. First recorded from the Hawaiian Islands by White, 1878:370.

This species has been found in a number of situations such as in *Pritchardia* palms in the mountains, in boxes, drawers, piles of wood, in clothes closets and about buildings. Kirkaldy (1907:151) suspected that it fed on silverfish and small cockroaches. Illingworth noted that Perkins found it feeding on a dead roach and reported that "These insects, in all stages, are often very common in the piles of dry wood in the shops of the College. I have never found them numerous in the house, but from time to time we find individuals. Upon two occasions we have taken them in the beds; and just recently, I caught an adult, full of blood, upon one of the sleeping children. The place bitten was red and resembled a flea-bite." (1917:274.) Illingworth's observations are of interest, for species of the genus have been found elsewhere in the nests of rodents and certain small mammals and have been reported to attack man. This bug needs detailed investigation. (See Herman Lent "Sobre o hematofagismo *Clerada apicicornis* e otros artropodos; sua importancia na transmissão da doença de Chagas." *Mem. Inst. Oswaldo Cruz,* 34:583–606, 1939.)

Kirkaldy (1907:151) gave a detailed description of the last nymphal instar. The terminal antennal segment on both the adult and nymph is conspicuously pale as compared to the remainder of the antennae.

Clerada apicicornis is a semi-domestic species, living and breeding freely in dirty houses and cupboards, where cockroaches are allowed to multiply. It also occurs in outhouses frequented by bed-bugs. On the other hand it can adapt itself to diverse conditions, and I have noticed adults and nymphs in numbers in dry sandy localities, living with various common cockroaches, especially *Periplaneta, Euthyrrhapha,* etc., beneath dead leaves. Curiously enough in the mountains it frequents the bases of the leaves of *Freycinetia,* like *Metrarga,* and was once found by me in company with these. (Perkins, 1913:cxciv.)

It has been collected at light.

Family **TINGIDAE** (Laporte, 1832) Westwood, 1840

Tingididae Fieber, 1860.
Tingitidae Stål, 1873.

Lace Bugs, Tingids

Most of the tingids are beautifully reticulated or bizarre in appearance, but they are represented in our fauna by only a single purposely introduced species. The head, pronotum and hemelytra are uniquely and coarsely sculptured in a con-

spicuously reticulated, lace-like pattern, the head is usually spinose, and the pronotum is often bulbous, and carinate or keeled, and it covers the scutellum. The antennae and rostra are four-segmented and the ocelli are wanting. There is no distinct clavus and the hemelytral membrane is entirely coarsely reticulated with the true veins obsolete. The tarsi are two-segmented and lack arolia. Our species cannot be confused with any other family represented in the archipelago.

See Opinion 143 of the International Rules of Zoological Nomenclature for spelling of the family name.

Subfamily TINGINAE (Amyot and Serville)

Tribe PHYSATOCHEILINI Blatchley, 1926:482

Genus **TELEONEMIA** Costa, 1864

This American genus contains many species.

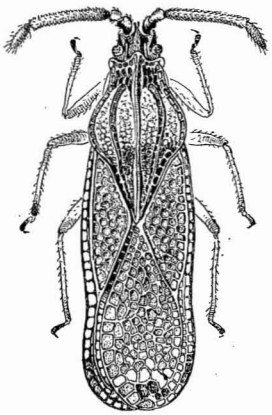

Figure 44—*Teleonemia scrupulosa* Stål. The lantana lace bug. (Drawn by Abernathy.)

Teleonemia scrupulosa Stål (figs. 44, 45).

Teleonemia scrupulosa Stål, 1873:132.

Teleonemia bifasciata Champion, of Kirkaldy, 1905:216, misidentification.

Teleonemia lantanae Distant, 1907:60.

Teleonemia vanduzeei Drake, 1919:24.

Drake and Frick, 1939:199–202, fig. 1, discussion and synonymy (some of their references are muddled). Kirkaldy, 1907:154, describes the last nymphal instar.

The lantana lace bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Introduced from Mexico by Koebele in 1902.

Hostplant: *Lantana.*

This common, widespread, slow-moving bug was purposely brought into Hawaii to aid in the control of *Lantana.* Sweetman (1936:360) said, "The great credit of inaugurating work on the biological control of noxious weeds belongs to the entomologists attached to the Hawaiian Sugar Planters' Association"—by virtue of the introduction of this bug. It has also been purposely introduced to Fiji and Australia.

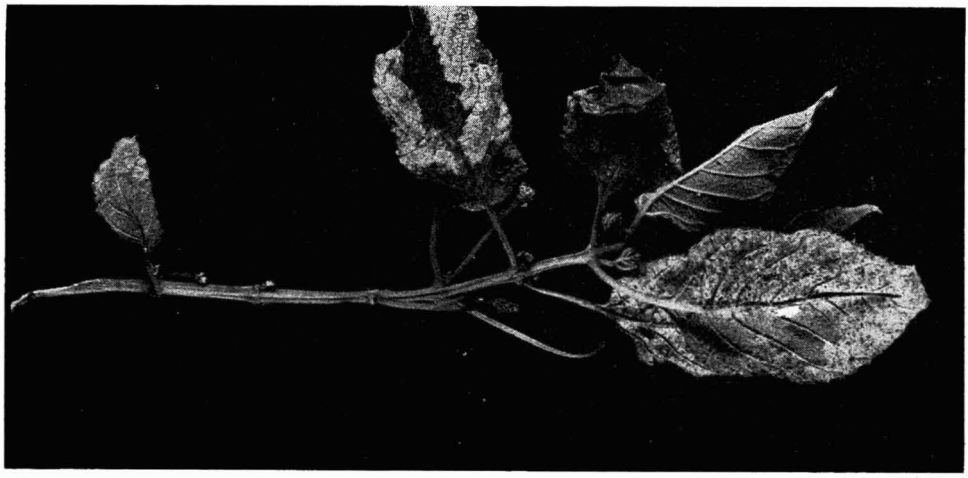

Figure 45—Leaves of *Lantana* showing damage caused by the feeding of the lantana lace bug, *Teleonemia scrupulosa* Stål.

This Tingid bug occurs generally throughout the Hawaiian Islands, wherever there is lantana, more especially in the dry regions. It is elongate oval, about one-eighth inch in length, of a greyish brown color. They feed on the foliage.... They also feed to some extent on the flowers, injuring them to such extent as to prevent fruit setting.

When feeding on the leaves the usual result is that the leaves are so injured as to be useless to the plant, and they dry up and fall to the ground. In the usual attack the bushes are soon defoliated and look dead, but it is only temporary. If weather conditions are favorable for it, another growth is put forth, to be again attacked, with the result that often the plant is prevented from flowering, and in this way this bug operates against seed production by lantana. By its continuous successive attacks in some of the drier regions, the bushes have become so much crippled that in connection with the dry climate they have finally died out entirely.

The eggs are laid in the peduncle and probably in the veins of the under side of the lantana leaves. They are laid at right angles to the surface, the apex and egg cap protruding. An egg is a little more than half a millimeter in length, cylindrical, swollen in the middle, white. It is not known how many eggs one bug will lay, nor how long it takes the eggs to hatch; but they are apparently prolific, for as many as 250 young bugs have been counted feeding on the underside of a single leaf, and all leaves of the same bush well supplied.

The young bugs are blackish, obscure, dirty looking creatures which get their growth in about two to three weeks, then by a final molt assuming the winged or adult form. This bug has not been known to breed on any other plant than lantana, though the adult bugs have been found resting on many other kinds of plants in the vicinity of lantana, or even at a distance, but this is only casual, and never in such numbers as to be injurious. (Swezey, 1924:75–76.)

Family **ENICOCEPHALIDAE** Stål, 1860

Henicocephalidae, of various authors.

Gnat Bugs, Unique-headed Bugs

This family is an associate of the Reduviidae, and, in fact, it has been placed in that group by some workers. Its peculiar head and pronotum, however, serve to distinguish it. Antennae and rostrum four-segmented; head constricted behind eyes and near base, the postocular part globose and with two ocelli situated behind eyes; pronotum with two transverse constrictions, therefore composed of three lobes; hemelytra entirely membranous, with large cells, veins and cross-veins comparatively few; fore legs with single-segmented tarsi, mid and hind tarsi three-segmented, arolia absent.

The above combination of characters makes the enicocephalids one of the most distinct and easily recognized of all of the Hawaiian Heteroptera. Although the family is world-wide in distribution, it is poorly known, and fewer than 100 species have been described.

Subfamily ENICOCEPHALINAE Ashmead, 1893

Genus **NESENICOCEPHALUS** Usinger, 1939:268

This genus was erected to receive two peculiar members of the family (one from Hawaii, the other from the Philippine Islands) which differ from all other known genera in having the discal cell closed and the basal discal cell wanting.

The present known distribution of the group is certainly not the natural one, and additional species, and probably allied new genera, will be discovered as more collecting is done in the tropical Pacific.

Nesenicocephalus hawaiiensis Usinger (fig. 46).

Nesenicocephalus hawaiiensis Usinger, 1939:268, fig. 1. Genotype.

Endemic. Maui (type locality: ridge above Haelaau, West Maui, 3,000 to 3,300 feet).

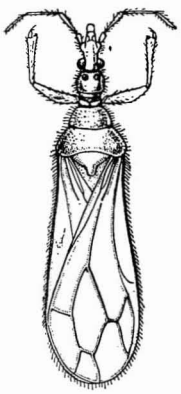

Figure 46—*Nesenicocephalus hawaiiensis* Usinger. (Cut loaned by Usinger.)

This small (2.32 mm.), fragile, gnat-like bug is known only from the unique type collected in 1928. It is strange that no other specimens of the family have been collected since. From the known habits of other members of the family, we would expect that this species, which is predaceous like its congeners, might be collected from dead vegetation or found in forest ground litter or under loose, dead bark. Also, it might be taken while swarming when it could be confused with chironomids or other flies in their nuptial flights. Some species have been collected at light.

Family **REDUVIIDAE** (Latreille, 1807) Stephens, 1829

Reduviids, Assassin Bugs, Kissing Bugs

The members of this large, widespread family are predaceous. Some species suck the blood of mammals and act as intermediate hosts of disease organisms, some of which are pathogenic to man. Only one subfamily, the Ploiariinae (Emesinae), has native species in the islands, although immigrant representatives of two other subfamilies have become established.

The following combination of characters will serve to characterize the family in Hawaii: rostrum three-segmented, curved (except in *Triatoma*) and not lying close against the under surface of the head; antennae four- or five-segmented; ocelli present or absent, when present situated behind the eyes; hemelytra, when present, complete and normal in our forms, clavus and corium present; tarsi one- to three-segmented, claws without arolia.

For a review of the higher classification of the reduviid series of families, see Usinger's "Revised Classification" (1943:602).

KEY TO THE SUBFAMILIES OF REDUVIIDAE FOUND IN HAWAII

1. Ocelli absent; fore coxae greatly elongated, longer than head ..... **Ploiariinae.**
   Ocelli present; fore coxae not elongated, much shorter than head. 2
2. First antennal segment shorter than head; head longer in front of eyes than behind eyes, and not constricted across dorsum in front of ocelli in our species..... **Triatominae.**
   First antennal segment much longer than head; head shorter in front of eyes than behind eyes and deeply constricted dorsally in front of ocelli in our species..... **Harpactorinae.**

Subfamily PLOIARIINAE (Dohrn, 1863)

Emesinae, of various authors (*Ploiaria* Scopoli, 1786; *Emesa* Fabricius, 1803).

The Thread-legged Bugs

This group, which has good differential characters, is considered by some authors to be entitled to a family status. The lack of ocelli, the long fore coxae, the long, slender, delicate body, greatly elongated, thread-like antennae and legs amply serve to distinguish the subfamily.

Usinger (1943:605) notes that "The Emesinae have elongate, spindle-like eggs with numerous longitudinal folds."

KEY TO THE GENERA OF PLOIARIINAE FOUND IN HAWAII

1. Fore tarsi fully one-half as long as tibiae, with single claws only; fore trochanters with one or two large, conspicuous spines ..... **Luteva** Dohrn.
   Fore tarsi only one-fourth or less as long as length of a tibia, claws paired; fore trochanters setose or hairy but not spinose.. 2
2. Fore femur without a differentiated basal spine... **Empicoris** Wolff.
   Fore femur with a large, stout, differentiated spine at base ..... **Nesidiolestes** Kirkaldy.

Genus **LUTEVA** Dohrn, 1860

In our fauna, the members of this genus most closely resemble those of *Empicoris,* but they are easily distinguished by their shorter tarsi. They are predaceous upon small insects such as psocids. They frequent plant foliage.

KEY TO THE SPECIES OF LUTEVA FOUND IN HAWAII

1. Hind legs without a white band at apex of tibiae and base of femora; penultimate antennal segment about twice as long as terminal segment; anterior trochanters each with a single spine ..... **insolida** White.

2. Hind legs with apices of tibiae and bases of femora white and obviously paler than remainder of legs; penultimate and terminal antennal segments about equal in length; anterior trochanters each with a pair of spines.....**insulicola** Kirkaldy.

Luteva insolida White (fig. 47).

Luteva insolida White, 1877:113.

Ploiaria collenetti Cheesman, 1927:95. Synonymy by China, 1930:145, fig. 24, with detailed redescription.

Oahu, Lanai, Hawaii. (No type locality designated by White.)

Immigrant. Known also from Samoa and the Marquesas Islands.

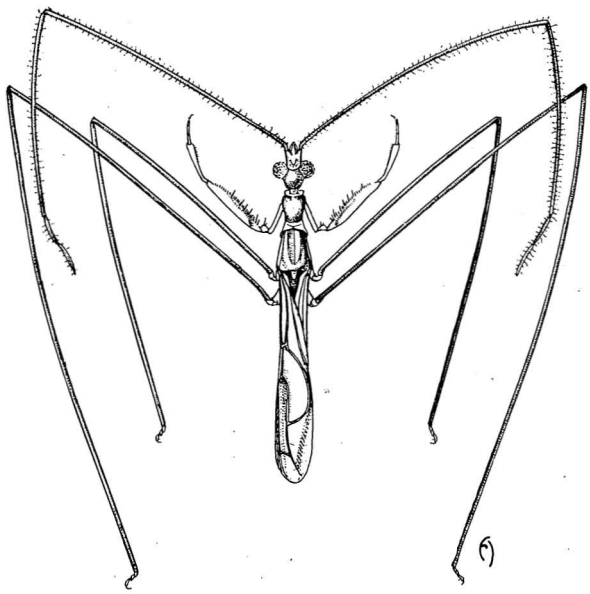

Figure 47—*Luteva insolida* White. (Drawn by Abernathy.)

Luteva insulicola Kirkaldy.

Luteva insulicola Kirkaldy, 1908:196.

Oahu (type locality: Waialua).

Immigrant (?).

Genus **EMPICORIS** Wolff, 1811

Ploiariodes White, 1881:58.

Genotype, *Cimex vagabundus* Linnaeus, the only species included by Wolff.

In addition to the differential characters mentioned under *Luteva* and in the key, our members of this genus may be distinguished from *Luteva* because the head and pronotum are dull and/or pilose and the pronotum is much shorter than the mesonotum. *Luteva* has a bare and more shiny dorsum, and its pronotum is about as long as the head or the mesonotum. The habits of the genus are similar to those of *Luteva;* they feed on psocids and other small insects and have been reported from spider webs. (See summary by Usinger, *Bull. Brooklyn Ent. Soc.* 36:206–208, 1941.)

I have not seen authentic specimens of *Empicoris pulchrus* and have been unable to separate it from the other species in the key. Kirkaldy (1902:151) separated *pulchrus* from *rubromaculatus* because he considered that the former did not have a reddish spot on the costal hemelytral margin. However, the red coloration is variable and may be present or absent in *rubromaculatus.*

Key to the Species of Empicoris Found in Hawaii

Excepting *E. pulchrus* (Blackburn).

1. Pronotum with a conspicuous keel-like tubercle at base of median line ..... **whitei** (Blackburn).
   Pronotum without a keel at base of median line..... 2
2. Length 3.6–3.8 mm.; hind femora half again as thick near base as at middle; distance between arms of male genitalia about three-fourths as great as depth of emargination..... ..... **minutus** Usinger.
   Length 5.0–5.5 mm.; hind femora only feebly thickened; distance across apices of arms of male genitalia greater than depth of emargination..... **rubromaculatus** (Blackburn).

Empicoris minutus Usinger.

Empicoris minutus Usinger, 1946:45.

Oahu.

Immigrant. Known also from Guam. First recorded from Hawaii by Usinger, 1946:46.

This species is closely allied to *rubromaculatus.*

Empicoris pulchrus (Blackburn).

Ploiariodes pulchra Blackburn, 1889:350.

Oahu (type locality: Konahuanui, about 2,000 feet).

Immigrant (?).

This species is unknown to me, and from the description it appears to be different from any of the other members of the subfamily in our collections.

Empicoris rubromaculatus (Blackburn) (fig. 48).

Ploiariodes rubromaculatus Blackburn, 1889:349.

See China, 1930:148, for synonymy.

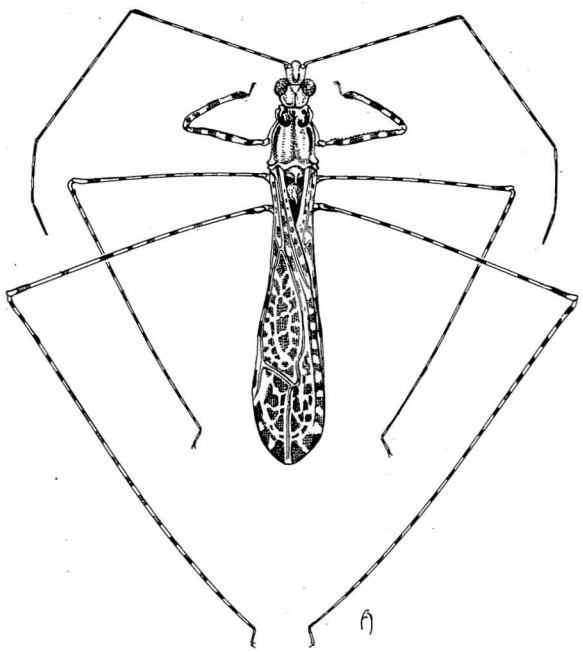

Figure 48—*Empicoris rubromaculatus* (Blackburn). (Abernathy drawing.)

The thread bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii (type locality: Mauna Loa, 4,000 feet), Midway.

Immigrant. North, Central and South America, Australia, New Zealand, Oceania.

Hostplants: *Clermontia,* ferns, *Ficus bengalensis, Maba sandwicensis, Metrosideros, Pritchardia.*

This is the commonest species of the genus in Hawaii as well as in America.

Empicoris whitei (Blackburn) (fig. 49).
Ploiariodes whitei Blackburn, in White, 1881:59. Genotype of *Ploiariodes.*

Oahu, Molokai, Lanai, Maui, Hawaii (type locality: Mauna Loa, 4,500 feet). Immigrant (?).
Hostplants: *Calpidia,* dead branches.

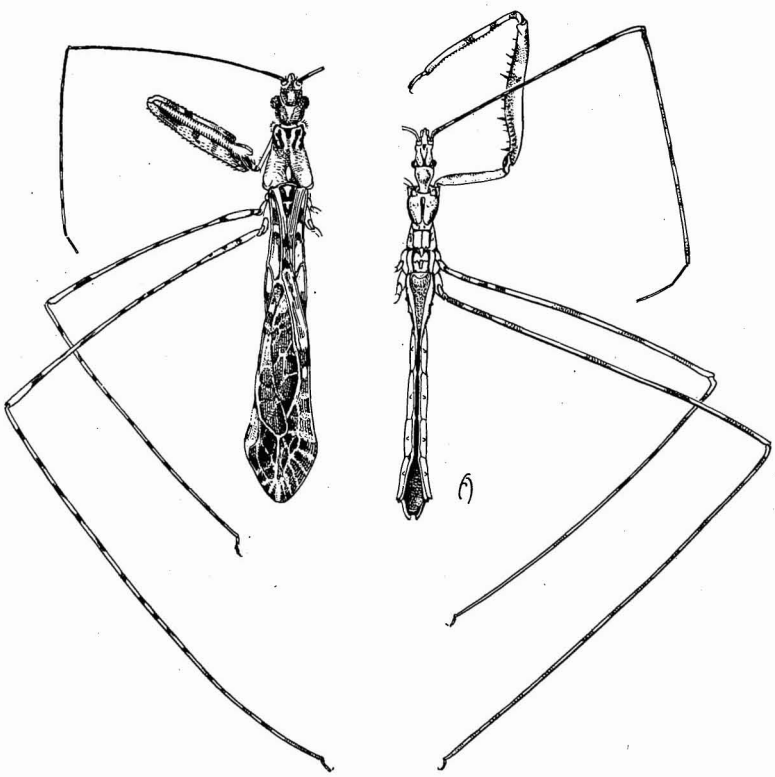

Figure 49—*Empicoris whitei* (Blackburn), left; *Nesidiolestes selium* Kirkaldy, right, drawn to one-half the scale of *Empicoris.* (Abernathy drawings.)

Genus **NESIDIOLESTES** Kirkaldy, 1902:152

This is an endemic genus which somewhat resembles South Pacific *Gardena.* All specimens collected have been apterous.

Nesidiolestes selium Kirkaldy (fig. 49).
Nesidiolestes selium Kirkaldy, 1902:153.
Nesidiolestes insularis Kirkaldy, 1908:195. New synonym.

Endemic. Kauai, Oahu, Hawaii (type locality: Olaa).

This large species frequents dead branches, foliage, ferns and clumps of grass.

There has been confusion regarding it ever since Kirkaldy described *insularis* (the type, from Mount Tantalus, 1,800 feet, Oahu, is in the collection of the Hawaiian Sugar Planters' Association Experiment Station, and I have examined it). Kirkaldy described *insularis* while in Honolulu, and he stated: "This differs so much from my description of *N. selium,* that I fear there is some mistake therein." Mr. China has kindly examined the unique male type of *selium,* which is in the British Museum, and states that it bears the specific name label *"olana,"* a manuscript name not published by Kirkaldy. As noted elsewhere, such a bad habit was all too common with Kirkaldy. Mr. China says, "I have compared it (the type) with Kirkaldy's miserable description of *N. insularis* and find that it agrees tolerably well." And "Under the circumstances I think you would be justified in sinking *N. insularis* Kirk. as a synonym of *N. selium* Kirk." We may expect to find the species on Molokai and Maui, and I am rather surprised that a series of allied forms has not been found.

Subfamily TRIATOMINAE (Jeannel)

Triatomini Jeannel, 1919.
Triatomidae Pinto, 1926.

The Triatomas

"Unfortunately, the family name Triatomidae has found extensive use in parasitological literature but there is absolutely no foundation for such a status, no characters were given by Pinto to separate it from such Reduviinae as *Physoderes,* and hemipterists have not generally accepted the name. To accept the family Triatomidae would require the elevation of twenty-three other subfamilies to family rank." (Usinger, 1943:608.)

Genus **TRIATOMA** Laporte, 1832

The single immigrant representative of this genus cannot be confused with any other Hawaiian bug. Its large size (about three-fourths of an inch long when adult) will separate it from all others. Its rostrum, instead of being strongly curved and held far from the lower side of the head as in our other Reduviidae, is nearly straight and is folded close to the head at repose. The eggs are laid free and are of simple form.

We are fortunate in not having more than one species of this genus in Hawaii, because several of its members are vectors of South American trypanosomiasis.

Usinger (1944) has written an excellent account of the species of North and Central America.

Triatoma rubrofasciata (Degeer) (fig. 50).

Cimex rubro-fasciatus Degeer, 1773:349, pl. 35, fig. 12.

Usinger, 1944:64, pl. 9a, redescription.

The bloodsucking cone nose, "kissing" bug.

Oahu.

Immigrant. First recorded from the Hawaiian Islands by Kirkaldy, who considered it to be a native South American species. "It has not previously been recorded from these Islands though known to the Entomologists for three or four years" (1904:185). Usinger (1939:46; 1944:65), however, has pointed out that although now it has tropicopolitan distribution, it is an Old World species, probably Indian.

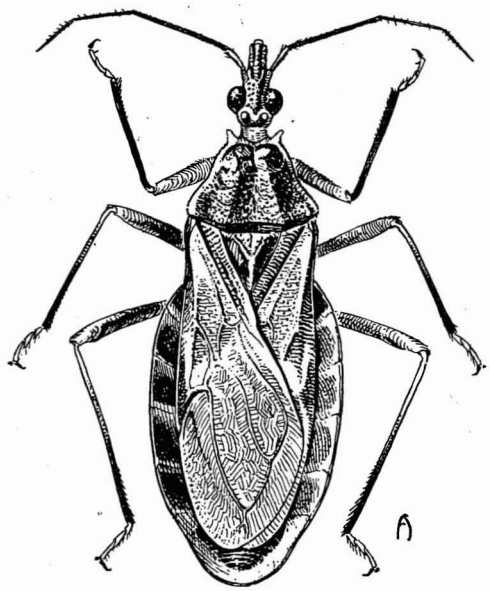

Figure 50—*Triatoma rubrofasciata* (Degeer). (Abernathy drawing.)

Hosts: sucks the blood of dogs, cats, pigeons, man, and probably rodents, other mammals and perhaps chickens and other birds. Little information regarding the hosts has been assembled in Hawaii. Illingworth (*Proc. Hawaiian Ent. Soc.* 9(3):374, 1937) reported finding it "breeding in hundreds in an old lumber pile.... This predaceous bug feeds on insects. In turning over the lumber one was found with its beak inserted in a dead American cockroach. One has to use care in handling them, for if given an opportunity they quickly sink their beaks into one's skin." I have failed to confirm Illingworth's observation as to their feeding on cockroaches. My captive specimens refused to feed on either dead or living cockroaches or other insects given them, and I do not believe that they are normally predaceous on other insects.

This species is known to be a vector of Chagas' disease (South American trypanosomiasis), which is caused by *Trypanosoma cruzi* Chagas, in Central and South America. In the Orient and Hawaii it is known to harbor another trypanosome, *Trypanosoma* (*Crithidia*) *conorhini* Donovan, which is not known to be pathogenic to man and whose vertebrate host is unknown, although it has been grown successfully in mice following artificial inoculation. For an extensive, detailed, abundantly illustrated account containing a lengthy bibliography of *T. conorhini,* see Morishita, 1935. For notes on the trypanosome in Hawaii, see Wood, 1946.

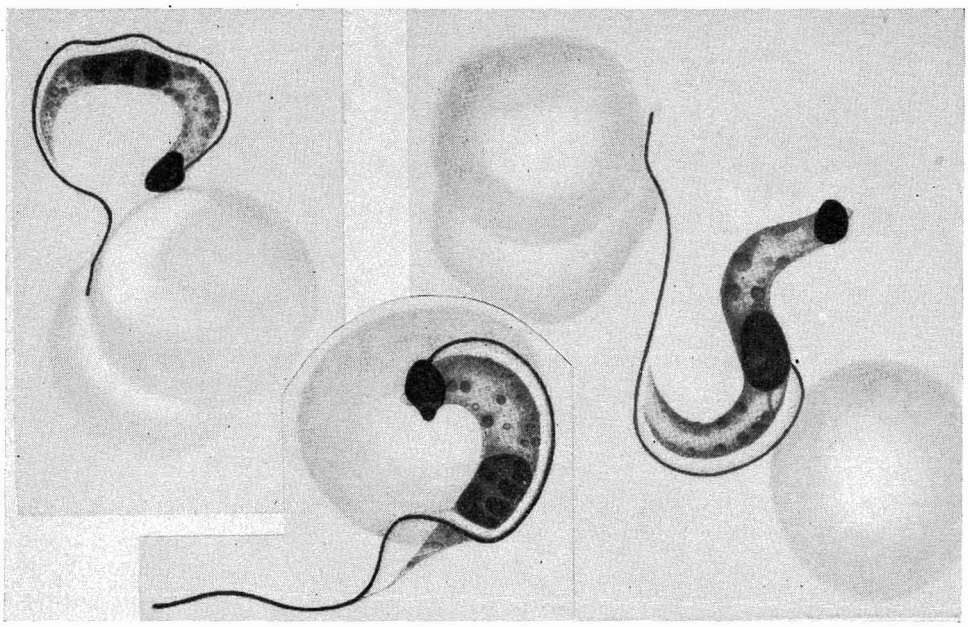

Figure 51—*Trypanosoma cruzi* Chagas with red blood corpuscles from an experimentally infected albino rat. (After Kofoid and Donat (1933); figure loaned by Fae Donat Wood.)

Trypanosoma cruzi has not been found in Hawaii, but there is danger of its being introduced. Because of this potential danger, I believe it desirable to place certain pertinent excerpts from Usinger's valuable 1944 paper on file here. The following data are quoted from pages 3 and 4:

In the insect the entire life cycle of the trypanosome occupies from 6 to 15 days and is passed within the lumen of the alimentary tract, only rarely reaching the malpighian tubules. The blood trypanosomes transform into crithidia in the stomach. These multiply posteriorly in the mid gut. In the hind gut the crithidia (non-infective) become smaller and give rise to metacyclic (infestive) trypanosomes. These are discharged with the excreta in varying numbers up to 3500 per cmm. No trace of trypanosomes is found in the salivary glands or in the body cavity. Transmission in humans occurs by rubbing the feces (which are excreted during or soon after feeding) into the wound or into skin abrasions by scratching, and by rubbing the feces into the conjunctiva of the eyes or into the mucous membranes of the mouth. Animals may become infected in the same manner as human beings and also by eating the bugs.

In vertebrates the trypanosomes are found in the peripheral blood for about two weeks. Fresh cover-slip preparations at this stage have been found to contain five or more trypanosomes in a thick drop of blood. Later these disappear from the peripheral blood and are found in the muscles of the heart and in other tissues. The incubation period in man is said to be 10 to 12 days.

A typical pathologic picture includes degeneration of invaded cells, cellular infiltration, and eventually fibrosis of the affected tissues. In acute cases all parts of the body are affected but most of the lesions are confined to the heart, brain, and liver. Congenital infection has been recorded by Mazza and Mayer (Strong, 1942).

"The most apparent symptoms," according to Dr. Mazotti, *in litt.*, "are fever and swelling of the eyelid and face (sign of Romana) usually accompanied with conjunctivitis and commonly unilateral."

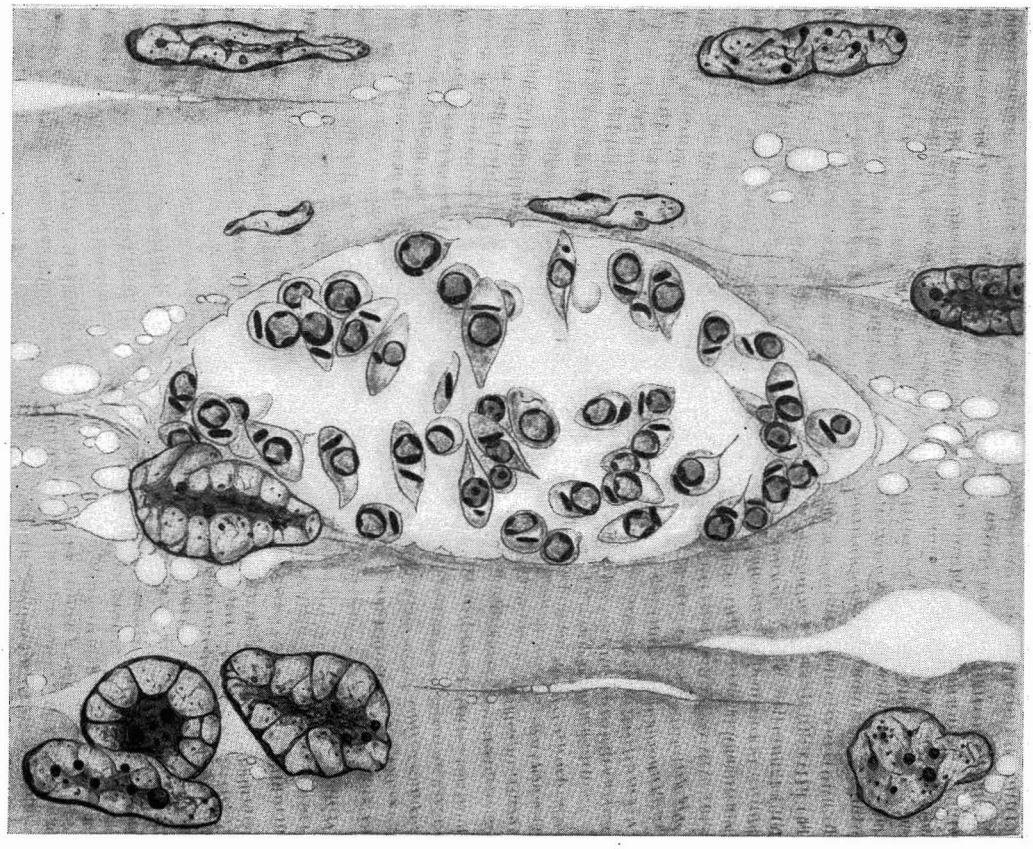

Figure 52—Developmental stages of *Trypanosoma cruzi* Chagas in heart muscle of albino rat. (After Kofoid and Donat (1933); figure loaned by Fae Donat Wood.)

Diagnosis is by inoculation of large volumes (5 cc. to 10 cc.) of blood into experimental animals and recovery of the trypanosomes in their peripheral blood. Here the dilution factor is so great that Brumpt (1914) developed a more sensitive technique called "xenodiagnosis" in which non-infected bugs are allowed to feed upon an infected animal. After multiplication in the alimentary tract of the bug, the trypanosomes are readily recovered or may be inoculated into another animal....

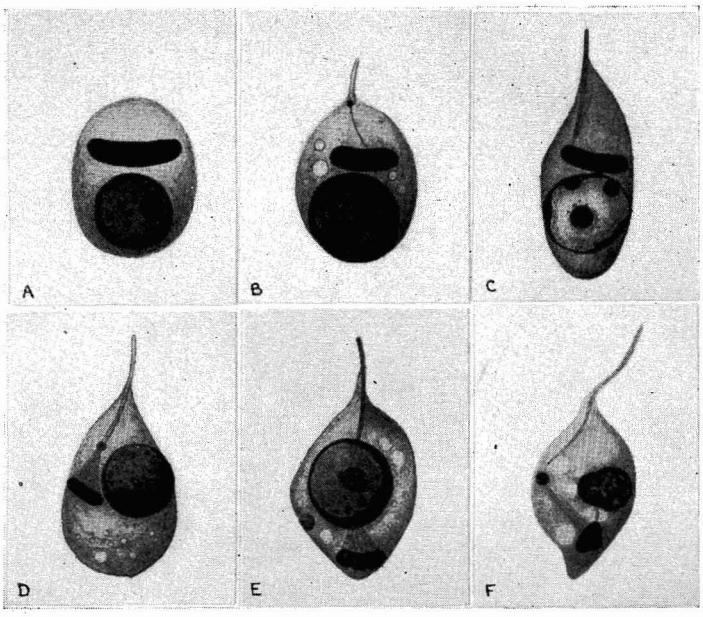

Figure 53—*Trypanosoma cruzi* Chagas from heart muscle of albino rat: **A,** leishmaniform stage; **B–C,** crithidial stages; **D,** transitional stage between crithidia and trypanosome; **E–F,** trypaniform stages. (After Kofoid and Donat (1933); figure loaned by Fae Donat Wood.)

Chagas' disease occurs in man throughout most of South and Central America from Argentina to Mexico. In Argentina, Mazza found 33 percent of 1722 bugs examined to be infected and 240 acute human cases with a fatality of 5.8 percent between 1932 and 1937. Many subclinical cases were suspected with a general weakened condition from constant reinfection. These latter cases result in myocarditis and early deaths.

There have been a few cases of complications resulting from the bites of this bug brought to the attention of physicians in Honolulu. Two of these have been reported upon by Arnold and Bell (1944:121) as follows:

Case 1. Mrs. E. R., a housewife, consulted one of us (D.B.B.) on March 28, 1943, because of 6 elevated red lesions, 1 to 3 cm. in diameter, on the inner aspect of the right forearm. These had awakened her by itching and burning early in the morning, and had later become reddened, swollen, and painful. At the time she was seen, a few hours after awakening, lymphangitis and axillary adenitis were present. The temperature was normal. After about three days the process subsided and the swellings disappeared.

On April 8 she returned with a painful, bluish-red swelling of the distal phalanx of the right fourth finger which had kept her awake all night. A small incision in the area produced free bleeding, but no pus. The pain and throbbing were relieved following the incision, and the swelling subsided. A reddened area on the dorsum of the middle phalanx could then be identified, which looked like the site of an insect bite.

The following day she returned with a red, painful, elevated lesion above the right eye, and redness and swelling of the eyelids on that side. On that day the patient was able to find and kill, in her bed, a large bug which was identified by C. E. Pemberton . . . as *Triatoma rubrofasciata* (Degeer).

Case 2. Mrs. C. W., housewife, was seen by one of us (H.L.A., Jr.) on November 2, 1943, because of a painful, sharply outlined, elevated papule about a half inch (12 mm.) in diameter on the ulnar edge of the left hand. She said she had been awakened about 2 o'clock that morning by intense itching and burning in that area, and that the lesion had gradually become painful and swollen.

When she was examined, some eight hours later, there was a broad, bright red streak extending from the involved area to the axilla, and decided tenderness in the axillary area. The following day the swelling and pain were more marked, despite the use of hot hypertonic saline compresses and elevation of the arm, and an incision was therefore made in the succulent-looking plaque on the hand. Serum and a little blood were obtained. Forty-eight hours later the swelling had subsided and the redness was fading.

The patient admitted having seen bugs in her house which answered the description of *Triatoma rubrofasciata,* and on the following day brought two live adult specimens to the office. Her home, like that of the first patient, was in Kaimuki, a dry, moderately elevated residential district on the southeast edge of Honolulu....

In January, 1944, I captured a female *Triatoma* which was flying about my bedroom at night, and from it I obtained a series of eggs and conducted some limited studies. The eggs are about 1.1×1.9 mm. in size, very shiny, creamy white, minutely sculptured, and they have a hard shell. If dropped, they rebound as though they were hard rubber pellets. One egg laid on February 10 hatched on March 7. The eggs were laid free and were either deposited in the cotton plug of the vial in which the female was confined, or were laid loose in the vial. In a vial covered with net, the female laid the eggs through the net meshes so that they dropped outside the confining vial. Eggs were laid at unequal intervals and at varying rates, perhaps as the result of artificial conditions and improper feeding. About 20 eggs were laid over a period of 20 days. The eggs become pinkish as embryonic development progresses, the dorsum collapses and becomes concave over the abdomen of the embryo so that it appears as if the eggs were spoiled. The black eye spots are plainly visible through the shell.

A first instar nymph was fed on my wrist on March 6. It selected one of the small wrinkles on the underside of the wrist to pierce. There was no sensation while it was feeding and no after effects. It fed continuously for 14.5 minutes and then released at repletion. At feeding, the abdomen first elongated and then swelled and became a beautiful cherry red as it filled with blood. At repletion the abdomen measured 2.75 mm. long (including the metanotum which merged with it), 2.2 mm. wide and 1.9 mm. high. The abdomen became so tightly swollen that the intersegmental lines became faint and the anus became terminal. (In the unfed nymph, the abdomen was depressed, the intersegmental lines well-marked, 1.1 mm. long to the mesonotum, 1.1 mm. broad, and the anus lay under the hind edge. The unfed nymph measured 2.5 mm. along the median line, and the fully fed nymph 4.25 mm. long.) On March 7, the abdomen had turned a dull black, was still tumid, and no feces were seen. By March 10 and 11 the ends of the abdomen had become brownish, otherwise there was no change, and no feces were seen. The specimen molted between March 17 and 24 during my absence from the laboratory. It fed for 15 minutes on my wrist on March 31, and there were very faint sensations as the beak was inserted. It died in molting on April 27.

A second lot of five nymphs were fed on a guinea pig. These were first fed on March 11. These molted between March 17 and 27, four of them by the 24th. One molted for the second time on May 14 or 15, one died molting on May 16, another died molting on May 17. The fourth was killed by the guinea pig host. The fifth molted again on June 19, again on July 23 or 24 and molted to an adult male on September 19. It died on December 16 of starvation.

A third lot of two first instar nymphs fed for 15 minutes on my wrist on March 13. No sensation was caused by their feeding. After several hours red spots 3 to 5 mm. across and which itched like mosquito bites appeared at the puncture sites. The itching lessened on March 15 and the red spots were reduced in size, although they were still somewhat itchy on March 16. One example molted on March 29, the other on the 30th. On March 31 I fed the specimen which had molted on the 29th on my wrist (the other failed to feed). No sensation was experienced, and a very slight, hardly noticeable pink color developed about the inserted beak, and this gradually spread. Eighteen minutes were needed to feed to repletion. A slight itching was noticed after 15 minutes and the pink spots enlarged to 2 mm. in diameter. On April 1 the spots had spread to 1 cm. in diameter, were red and itched. On April 3 the spots were reduced to 3 mm. in diameter, but they were still somewhat itchy. On April 5 they had reduced to 1.5 mm. across and were elevated. On April 6 the second nymph fed on my wrist for 19 minutes. The itchy bites spread as red spots to about 1 cm. in diameter. It should be noted that red spots appeared at the puncture sites even if the bug fed at the spot for only a moment. Thus, if the bug did not feed continuously at one place, a red spot developed for each puncture made. One of the nymphs molted on May 12, the other on May 18. One molted on July 9 or 10, again on August 9 or 10, and it emerged as an adult female on October 20. It was fed part full on October 31 and was not fed again before it died on December 1.

The itching was so annoying that I discontinued feeding the bugs on myself and used guinea pigs for the purpose. The guinea pigs were bothered by the bites also, and one female, after being fed upon several times, trembled violently every time I tried to feed the bugs on her and became useless as an experimental host.

The bugs frequently refused to feed. As can be seen from the above notes, they can go a long while without feeding. Adult specimens, when fed to repletion, frequently fed continuously for half an hour, and from two to three hours or more elapsed before defecation of the dark, digested blood took place. None of the specimens studied passed feces during or shortly after feeding as has been reported for several other species.

When attacking, the bugs use stealth and carefully approach their objective. When in a favorable position, they extend their beaks forward, raise up on their legs, and then drive their proboscis into the host with a startling, lightning-like thrust which, surprisingly enough, is not or is hardly felt by the host. The bugs are easily disturbed, especially when beginning to feed.

In contrast to the painless piercing when the bug attacks to feed, is the sharp and painful wound it inflicts in self-defense. Thus, if a bug is picked up in the

fingers, it may "bite" viciously in its attempt to get away and at the same time throw off an offensive musk. Reports have come to hand of persons being bitten by some insect while gardening, and the blame has been placed upon *Triatoma.* This is highly improbable, I believe, for the wounds more probably were inflicted by scorpions, centipedes or perhaps spiders. *Triatoma* are secretive insects which are normally active and attack at night, and if disturbed in the daytime they will attempt to get away to hiding with much speed and agility. They do not feed if excited or annoyed.

Subfamily HARPACTORINAE (Amyot and Serville)

Assassin Bugs

We have in Hawaii a single immigrant representative of this, the largest subfamily of the Reduviidae. The presence of a pair of ocelli and a much stouter body easily serve to distinguish it from the Ploiariinae. Its very different head and rostrum together with the fact that the connexivum is almost or entirely hidden by the hemelytra, whereas it is broadly exposed in the Triatominae, distinguish it from the Triatominae.

Genus **ZELUS** Fabricius, 1803

This is a large, mostly tropical American genus.

Subgenus **Diplacodus** Kirkaldy, 1900

Zelus renardii Kolenati (fig. 54).

Zelus renardii Kolenati, 1856:460, pl. 3, fig. 2.

Zelus peregrinus Kirkaldy, 1902:149.

Bionomics: Swezey, 1905:232–234, pl. 16, figs. 1–3. Kirkaldy, 1907:156–158.

The leafhopper assassin bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Immigrant. A western North American species described from California. First found in Hawaii near Honolulu by Perkins in 1897.

This is a common, widespread, predaceous insect which frequents many kinds of plants and feeds upon almost any arthropods it can catch and hold. "An example of their voracity is shown by the following observation: 17 adult [sugarcane] leaf-hoppers were confined with an adult female *Zelus,* and within 24 hours she had eaten 14 of them. The same female ate flies of various species; ladybugs, young and adult; spiders; nymphs of her own species; and, in fact, one day ate the adult male which was confined with her; in another instance a full grown nymph ate an adult which had just molted and was still soft and unprotected." (Swezey, 1905:233.) During the great outbreak of the sugarcane

leafhopper, this species was abundant in the sugarcane fields where it played a beneficial role in reducing the numbers of leafhoppers. It feeds upon aphids, but may also feed upon ladybird beetles which feed upon aphids and coccids, thus, in part, nullifying some of its beneficial work. The young nymphs have been observed feeding on "red spiders." "It preys upon very different kinds of insects, and the adults will destroy many kinds of beetles such as Dermestids, Coccinellids, and Tenebrionids, and even the hard Hymenopterous genus *Chalcis*. The young feed on softer creatures, especially *Aphis,* young leaf-hoppers, etc., which are also attacked by the mature bugs." (Perkins, 1913:cxcix.)

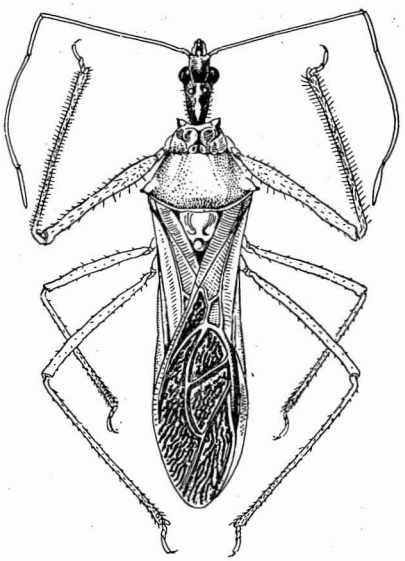

Figure 54—*Zelus renardii* Kolenati, the leafhopper assassin bug. (Abernathy drawing.)

The subcylindrical, brown, sticky eggs are between 1.2 and 1.5 mm. in length, the operculum is whitish and is depressed below a raised peripheral fringe. They are deposited in columnar clusters, each usually containing 20 to 40 or more eggs. A female observed by Swezey laid 269 eggs during a period of a little more than a month in batches that averaged five days apart. The incubation period is 8 to 10 days.

The nymphs are more or less sticky in all stages. The abdomen is rather ovate in shape and somewhat flattened above; in the younger stages it is much tilted up behind. Eyes red; legs white, ringed and spotted with black; stages 1 and 2 have black spines at tip of abdomen; 3, 4 and 5 have the spines also on the sides of the abdominal segments, increasing in size from before backwards. Full grown nymph is of a light bluish green color, with some reddish yellow markings on dorsum, segmentally arranged. (Swezey, 1905:234.)

Kirkaldy (1907:157–158) gave a detailed description of the fifth instar nymph. There are probably about four to six generations a year. An entire life cycle may take a few days less than two months.

Family **NABIDAE** (Costa, 1852) Dohrn, 1859

Nabids, Damsel Bugs

This cosmopolitan group of predaceous bugs is united with the Reduviidae by some workers. Many of our species resemble the reduviid *Zelus*. The prosternum lacks the specialized stridulatory groove characteristic of the Reduviidae; the rostrum has four instead of three segments, and it is also longer in our species than in the Reduviidae, for it extends well behind the fore coxae. The antennae are four-segmented. Two ocelli are usually present, but are obsolescent in some forms and absent in others. Our species either have the wings fully developed with the hemelytra with clavus, corium and membrane distinct and the veins conspicuous in all three parts, or they are variously modified and reduced so that some species are brachypterous or micropterous. The tarsi are three-segmented; the claws lack arolia. The female ovipositor is well developed, and the male genital claspers are large and conspicuously exposed at the sides of the end of the abdomen. The eggs are inserted in plant tissues, an unusual habit for the reduviid series of families.

This is one of the most specifically complexly developed groups of bugs in the Hawaiian Islands and is one of the most intriguing groups of all Hawaiian insects from an evolutionary standpoint.

Subfamily NABINAE (Reuter, 1890)

Tribe NABINI Van Duzee, 1916

Genus **NABIS** Latreille, 1802

Reduviolus Kirby, 1837.
Coriscus Stål, 1873.
Milu Kirkaldy, 1907.
Nesotyphlias Kirkaldy, 1907.
Nesomachetes Kirkaldy, 1908.

Genotype: *Cimex ferus* Linnaeus, fixed by Westwood, 1840.

This genus contains 26 described forms in the Hawaiian Islands, but there is a large number of undescribed species known to us. Some of these new species are among the finest in the genus. We may learn that there are more than 50 species here. In contrast to this, Harris in 1928 listed 22 species from all of America north of Mexico. The native Hawaiian species "... may very reasonably be considered to have all developed from one original immigrant, possibly indeed from *R. blackburni*." (Kirkaldy, 1909:49.)

The great differences in the development of the tegmina and wings among our many species of *Nabis* are remarkable and offer a magnificent field for studies in evolution. The species can be divided into two major groups. The first group contains the more primitive or conservative species, or those normal, fully winged insects capable of active flight. The second group consists of radically changed species with wings and tegmina reduced to various stages of obsolescence or abortion, and none of these insects can fly. Some of them have the tegmina as long as or longer than the abdomen, and there is a series of forms (including undescribed species) which grades down to species in which the tegmina are reduced to mere coriaceous flaps. In all of these flightless forms, the corium and clavus are not sharply demarked one from the other, and in all the membrane is reduced or is vestigial. The hind wings are vestigial in all of them. In the winged forms, the ocelli are normal and fully developed, whereas they are obsolescent or absent in the brachypterous forms. In the flying forms the hind lobe of the pronotum is strongly developed and the middle lobe is on a somewhat lower plane. However, on the flightless forms, the middle lobe is strongly developed, is tumid, and, in most species, it rises high above the posterior lobe.

Among all of our many species, there is only one known form which tends to bridge the gap between these two groups of species. This is *Nabis blackburni,* the most widely distributed of our endemic species and the one which has been reported from the largest number of hostplants. Specimens from the high or wet mountains display a unique variability in the development of the tegmina and hind wings, and in some examples these organs are reduced to the point where the specimens can be called brachypterous, although the development does not go as far as it does in our normally flightless species. In this one species, the lobes of the pronotum vary as do the wings, and on the brachypterous forms the middle lobe is more elevated than is normal for the species. However, the ocelli remain fully developed, even in the most brachypterous examples examined.

The male genital claspers, or parameres, afford excellent means for the separation of most of the species. These organs lie exposed on either side of the genital capsule and are usually examined easily without dissection. The apical part of the claspers may be hidden beneath the posterior edge of the tergite next in front of the genital capsule, and thus the shape may appear to be different than it is if one does not check his specimen carefully. In interpreting the camera lucida sketches of the claspers, one should keep in mind that in nature the organs are twisted and bent in various ways which cannot be shown adequately in such outlines. In drawing them, I have oriented the specimen so that the broadest lateral view was obtained.

One might expect predaceous bugs such as these to be catholic in their hostplant relationships, for they feed upon psocids, nymphal orthopterans, Diptera and other small, soft-bodied insects which are found on a variety of plants. However, the species appear to have definite hostplant preferences. For example, *kahavalu* is attached to *Sophora, tarai* to *Styphelia, subrufus* to *Metrosideros* and *truculentus* to *Pipturus.* The widespread *blackburni* and *capsiformis* have been reported from

many kinds of plants. Other species appear to be attached to given plants, but our information is incomplete. The flightless forms are usually ground, grass, sedge, fern and herb frequenters, although some of them overlap into shrubs and trees. At least some of the species attached to *Metrosideros* have a reddish or dark coloration that is characteristic of other native groups of Heteroptera and Homoptera attached to that myrtaceous tree. I feel that a detailed study of the hostplant relationships of these predaceous insects would be a profitable undertaking that might cast new light on evolutionary problems.

If one is accidentally bitten by a *Nabis,* the wound is apt to swell and form a red welt accompanied by pain for a considerable time.

It is unfortunate that Kirkaldy's several papers on this splendid group have created such confusion. Several of his one-sentence descriptions are worthless, and even some of his more detailed descriptions do not include enough comparative matter to enable identifications to be made. For example, his description of the unique female holotype of *silvicola* reads, in addition to size and locality, "Scarcely to be distinguished from *lusciosus,* but the membranal venation is different and the ocelli more distinct." Another original description states simply "*Kahavalu* sp. nov. *R. innotatus* Kirkaldy, an endemic Hawaiian form; (not Blackburn)." In his papers he misidentified, misinterpreted, combined or separated various forms in a variety of incorrect ways. Although he examined Blackburn's types, he confused the species. Many of the locality and distribution records in his work are confusing, unreliable or inaccurate.

Hence, the task of revising the group is not an easy one. However, it is fortunate that there have been available for study fairly extensive and representative collections. I have before me the holotypes of the four species described by Blackburn, the one species described by Van Duzee, and two of the forms described by Kirkaldy. Cotypes of some of Kirkaldy's other species are also at hand. Kirkaldy examined White's types and correctly interpreted the species.

In Kirkaldy's first paper (in "*Fauna Hawaiiensis,*" 1902), he listed eight species in *Reduviolus.* In his second paper (1907) he erected the new genus *Milu* to include "*kerasphoron*" (a new name for the species he had confused in his 1902 paper as Blackburn's *rubritinctus*). In his third paper (1907) he erected the new genus *Nesotyphlias* for *lusciosus* and corrected a few errors. In the fourth paper (1908) he listed 25 species and one variety, and erected the new subgenus *Nesomachetes* for his *kahavalu.* In his fifth paper (1909), entitled a revision of the family for Hawaii, he listed 24 species and two varieties, ignored his *Nesomachetes,* dropped his *Milu* as "not worthy of more than subgeneric rank," and his *Nesotyphlias* (p. 192, footnote) was disposed of as not to be "regarded as a genus, but rather as a natural group produced under special circumstances." In his last paper on the group ("*Fauna Hawaiiensis,*" supplement, 1910), he used *Milu, Nesotyphlias* and *Nesomachetes* as subgenera and listed 22 species, ignored his varieties and omitted several species. However, some of this confusion may not have been entirely Kirkaldy's fault. Dr. Usinger has pointed out to me that Kirkaldy's 1910

paper may have been written before his 1909 paper and that he may not have seen the proofs of some of this work.

Kirkaldy erected *Milu* because of its "incrassate first segment of the antennae and the prominent blunt spine arising well in front of the antennal insertion from the side of the head, which I formerly overlooked, but which has been pointed out to me by Dr. Perkins" (1907:247). *Nesotyphlias* was separated from *Reduviolus* "by the absence of ocelli, by the clavus being fused with the corium, and by the minute membrane" (1907:155). *Nesomachetes* was "characterized by the almost straight lateral margins of the pronotum and consequently feeble elevation of the hind lobe, by the immaculate scutellum and non-annulate antennae and legs" (1908:190).

Because of the great between-the-species variability and multiform development displayed in our species, these groups are largely meaningless. If isolated species were taken to compare with a normal group of bugs from a continent, a taxonomist would perhaps have little choice but to erect several distinct genera for them. However, in this insular fauna such startling divergent types are obviously allied

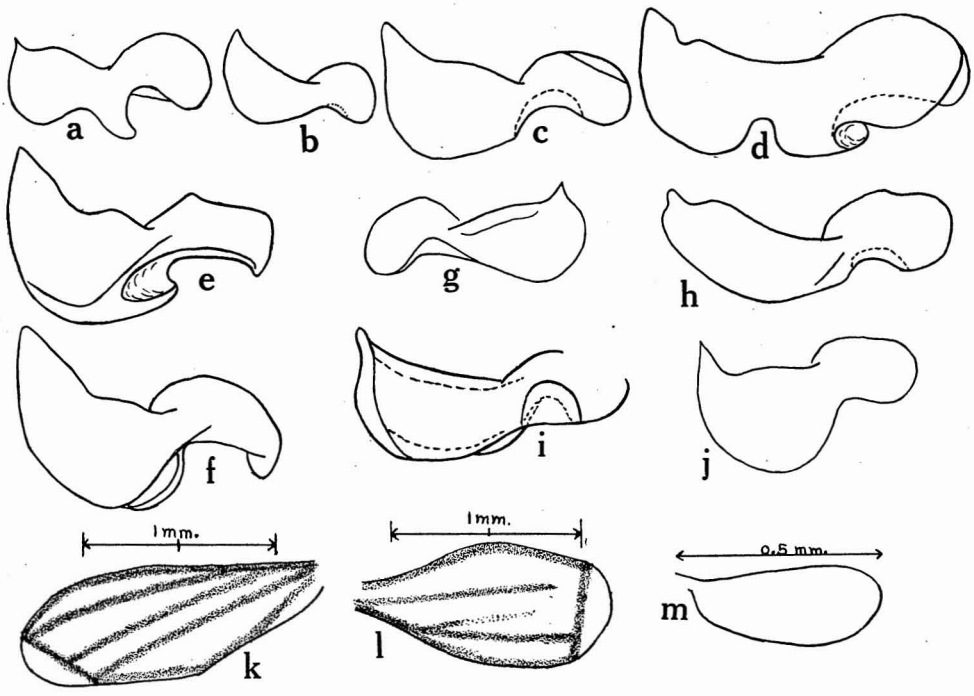

Figure 55—Features of *Nabis* species: **a,** left male clasper of *N. blackburni* White; **b,** the same of *N. capsiformis* Germar; **c,** the same of the holotype of *N. giffardi* Van Duzee; **d,** the same of *N. kahavalu* (Kirkaldy), cotype; **e** and **f,** the same of *N. curtipennis* Blackburn, holotype (**e,** viewed more ventrally oblique, **f,** viewed more dorsally oblique); **g,** right clasper of *N. kaohinani* (Kirkaldy), holotype; **h,** left clasper of *N. kerasphoros* (Kirkaldy); **i,** the same of *N. koelensis* Blackburn; **j,** the same of *N. lolupe* (Kirkaldy); **k,** left hemelytron of *N. kaohinani* (Kirkaldy), male holotype; **l,** the same of a male *N. lolupe* (Kirkaldy) (the middle vein is developed in the two females I have seen); **m,** hind wing of *N. curtipennis* Blackburn, holotype.

specific developments, in some instances very closely allied genetically, and many intermediate species exist, some of them side by side in the field. Kirkaldy put it aptly when he said (1909:57) "I have proposed a mutation-name, *Nesotyphlias*. It is not strictly a genus, or even perhaps a subgenus in an exotic sense, but it is certainly not equivalent to the ordinary brachypterous forms of the genus in Europe and North America. *The Hawaiian fauna is very peculiar and must be treated in a special manner.*" [Italics mine.] There is only one species (including a color variety) with the cephalic horns of *"Milu kerasphoron,"* but the horns represent a simple enlargement of less-developed processes found on all of the species. In this work, Kirkaldy's subgenera are not used.

The types of the species in the British Museum were checked through the following key by Mr. W. E. China. His cooperation is gratefully acknowledged.

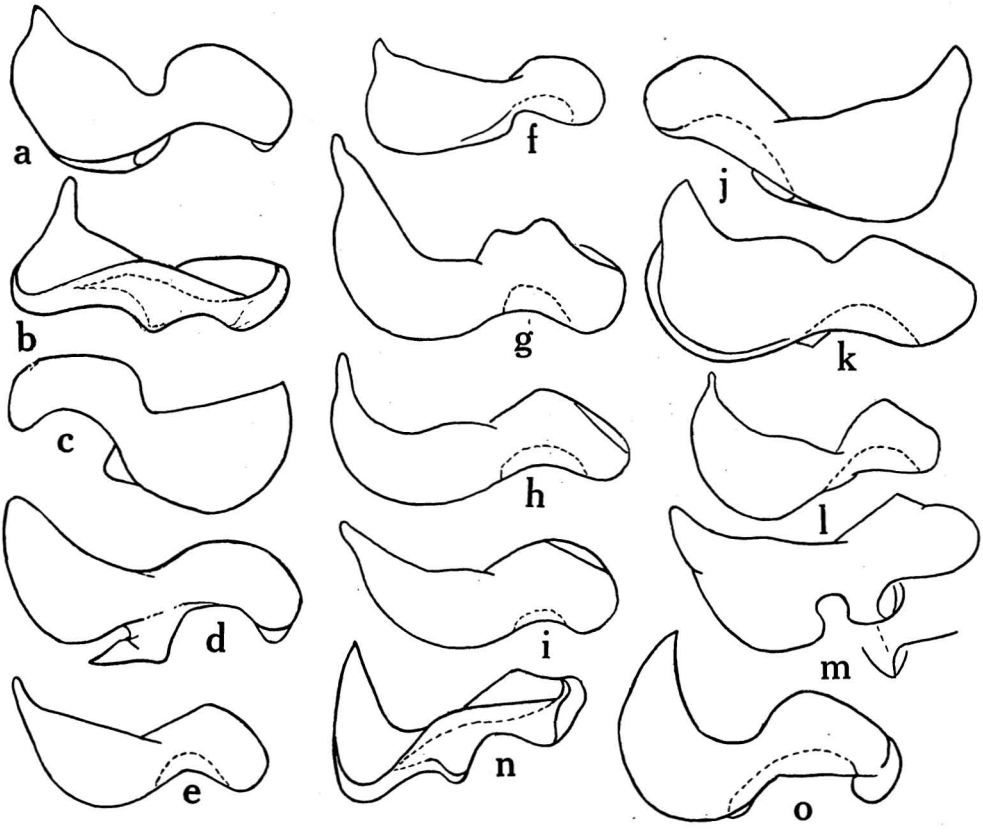

Figure 56—Lateral views of male genital claspers of *Nabis* species: **a, b,** *N. lusciosus* White (**b,** oblique from beneath), left clasper; **c,** *N. pele* (Kirkaldy), right clasper; **d,** *N. procellaris* (Kirkaldy), left clasper; **e,** *N. truculentus* (Kirkaldy), left clasper; **f,** *N. morai* (Kirkaldy), left clasper; **g,** *N. nubigenus* (Kirkaldy), left clasper of cotype from Molokai; **h,** left clasper from the same species, but from an example from Maui; **i,** left clasper from the same species, but from an example from Lanai; **j,** *N. oscillans* Blackburn, right clasper of holotype; **k,** *N. rubritinctus* Blackburn, left clasper; **l,** *N. subrufus* White, left clasper; **m,** *N. tarai* (Kirkaldy), left clasper; **n, o,** *N. silvestris* (Kirkaldy), left clasper (**n,** from oblique beneath).

KEY TO THE HAWAIIAN SPECIES OF NABIS

1. Ocelli conspicuous and well-developed; middle lobe of pronotum not strongly convex as noted below, but on a somewhat lower plane than posterior lobe (except in *nesiotes* and some specimens of *blackburni*) 2

Ocelli absent or obsolescent (see *silvicola*, fig. 68, for example of obsolescent ocelli); middle lobe of pronotum tumid and usually strongly convex so that when viewed from side its middle part is on a higher plane than either anterior or posterior lobes; wings reduced 17

2(1). Head with a conspicuous, remarkable, stout, upturned horn on either side of median line in front of bases of antennae; first antennal segment incrassate 3

Head without such horns 4

3(2). Basal part of tegmina as far as beginning of membrane distinctly paler than remainder of corium which is thus bicolored; Oahu ..... **kerasphoros kerasphoros** (Kirkaldy).

Corium not bicolored, but entirely predominantly reddish; Oahu ..... **kerasphoros purpureus** (Kirkaldy).

4(2). First antennal segment not longer than median length of pronotum (do not include basal antennal tubercle in measurement), usually distinctly shorter, rarely about as long 5

First antennal segment longer than pronotum, length usually equal to length of pronotum plus back of head up to ocelli 13

5(4). Stout or comparatively stout brownish species with clavus and corium set with numerous, conspicuous, large, coarse, irregular punctures which are darker than surrounding derm 6

Tegmina without such coarse punctures, or with some limited to outer apical part of corium; mostly comparatively elongate species 7

6(5). Membrane of tegmina with veins not greatly broken up, but mostly line-like; first antennal segment longer than breadth of head through eyes; apical part of male genital clasper broad and rounded with a small, dorsal, tooth-like point; Kauai ..... **morai** (Kirkaldy).

Veins of membrane conspicuously broken up to form many spots and isolated patches; first antennal segment shorter than breadth of head through eyes; apical part of male clasper acuminate and more sickle-shaped; Lanai, Maui, Molokai ..... **nubigenus** (Kirkaldy).

7(5). Widest part of pronotum at least twice as broad (in most species more than twice as broad) as breadth of head through eyes (only twice as broad in *kahavalu*) (this is a weak part of the key and may require revision) 8

Widest part of pronotum less than twice as broad as head across eyes 11

8(7). Corium conspicuously bicolored, anterior half yellow, posterior half red; Kauai.....**sharpianus** (Kirkaldy).
Corium entirely or almost entirely predominantly yellowish or brownish, or variously tinged with red, but never bicolored as in *sharpianus*..... 9

9(8). An outstanding and unusually marked species from Oahu; dorsum basically pale brown entirely marked with numerous darker brown lines and dark areas; membrane pale with veins dark and very prominent even to unaided eyes; veins on corium alternating pale and dark colored; posterior lobe of pronotum prominently multivittate .....**truculentus** (Kirkaldy).
Not such species 10

10(9). Pronotum distinctly more than twice as broad as head through eyes, posterior lobe on a distinctly higher plane than middle lobe; a yellowish-brown species with some veins of densely opaque corium tinged with red, or entire corium reddish; hind wings dark; femora spotted; Maui .....**rubritinctus** Blackburn.
Pronotum only twice as broad as head through eyes, posterior lobe hardly more elevated than median lobe; in life pale green, fading to pale yellowish or yellowish-brown after death; tegmina pale, translucent or milky subtranslucent; membrane not very sharply marked off from corium in texture; hind wings pale; femora pale, not spotted; a conspicuously pale species with characteristic male genital claspers, as illustrated (fig. 55, d); Hawaii .....**kahavalu** (Kirkaldy).

11(7). Middle lobe of pronotum distinctly convex and raised above level of posterior lobe; general color dark chocolate-brown, underside pitchy black....**nesiotes** (Kirkaldy).
Middle lobe of pronotum not convex nor raised above level of posterior lobe; general color grayish-yellow or reddish-brown, underside pallid.....11a

11a(7). Entire insect, especially dorsum, tinged with pinkish or reddish; male clasper as illustrated (fig. 56, m); on all main islands.....**tarai** (Kirkaldy).
Species predominantly grayish, yellowish and brownish and not conspicuously tinged with red.....12

12(11). Tegmina with numerous dark marks; legs conspicuously spotted; male claspers each with a strongly developed tooth on lower margin as illustrated (fig. 55, a); on all main islands.....**blackburni** White.
Tegmina nearly uniformly pale in color; legs at most feebly marked; male claspers rounded beneath and without a tooth, as illustrated (fig. 55, b); on all islands .....**capsiformis** Germar.

13(4). Femora, excepting for at most a dark apex, pale and without numerous spots; pale species from Hawaii.....
.....**giffardi** Van Duzee.
Femora with many distinct spots.....14

14(13). An outstanding and unusually marked species from Oahu; dorsum basically pale brown entirely marked with numerous darker brown lines and dark areas; membrane pale with veins dark and very prominent even to unaided eyes; veins on corium alternately pale and dark colored; posterior lobe of pronotum prominently multi-vittate (Note: Although the specimens I have seen actually belong in 4(2) above, I have placed the species here also, because the first antennal segment is nearly as long as the pronotum, and unless carefully measured it might be run to this section of the key.) . . . . . **truculentus** (Kirkaldy).

Not such species 15

15(14). Tibiae normally conspicuously multi-annulate, rings of color usually obvious to unaided eyes (an occasional confusing specimen has the rings hardly visible, however); Oahu . . . . . **subrufus** White.

Tibiae concolorous (at most only apex dark, never multi-annulate); not Oahu species 16

16(15). Male clasper terminating in a broad, comparatively blunt apex as illustrated (fig. 56, j); Hawaii . . . . . **oscillans** Blackburn.

Male clasper terminating in a more slender, sharper apex as illustrated (fig. 55, i); Lanai and Hawaii . . . . . **koelensis** Blackburn.

17(1). Tegmina, even if abbreviated, reaching behind fifth abdominal segment 18

Tegmina greatly abbreviated, at most reaching only slightly behind first abdominal segment, membrane nearly obsolete; antennae at least in part conspicuously multi-annulate 22

18(17). Tegmina obviously shorter than described below and always leaving genital capsule and usually one or two other abdominal segments exposed behind; male genital capsule always exposed; male claspers as illustrated (fig. 55, e, f); Hawaii . . . . . **curtipennis** Blackburn.

Tegmina reaching to or beyond apex of abdomen (an occasional gravid (?) female may have part of genital segment exposed, but genital capsule always concealed in males) 19

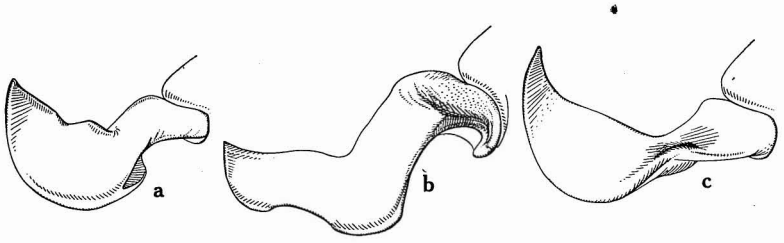

Figure 57—Lateral views of male genital claspers of *Nabis* species: **a,** *N. curtipennis* Blackburn (from the holotype of *Reduviolus volcanicola* Kirkaldy); **b,** *N. nubicola* (Kirkaldy), holotype; **c,** *N. paludicola* (Kirkaldy), holotype. (Drawn at the British Museum of Natural History by Smith.)

19(18). Molokai species 20
Not so 21

20(19). Male genital capsule with each exterior angle behind and below attachment of each clasper produced as a stout, conspicuous, boss-like protuberance (best seen when viewed from rear); claspers each with a peculiar, forward-projecting, sharp, hook-like process on lower midsection (fig. 56, d); female holotype as illustrated (fig. 67), with hemelytra with extreme length of inner edge of membrane shorter than clavus, middle apical cell of corium shorter than pronotum.....**procellaris** (Kirkaldy).
Male unknown; female holotype as illustrated (fig. 68), with extreme length of inner margin of membrane longer than clavus, middle apical cell of corium longer than pronotum (these lengths vary somewhat individually, and the cell may not be quite as long as the clavus, but the hemelytra are obviously more slender with longer cells, as illustrated, than those of *procellaris*).....
.....**silvicola** (Kirkaldy).

21(20). Hawaii species; male clasper as in figure 56, c.....
.....**pele** (Kirkaldy).
Maui species; male clasper as in figure 57, b.....
..... **nubicola** (Kirkaldy).
Oahu species; male clasper as in figure 56, a, b.....
..... **lusciosus** White.
Kauai species; male clasper as in figure 56, n, o.....
.....**silvestris** (Kirkaldy).

22(17). Corium nearly truncate behind, membrane thus situated more transversely than obliquely; Kauai..**lolupe** (Kirkaldy).
Corium strongly oblique apically which in turn results in membrane being placed obliquely; Oahu and Molokai species.....23

23(22). Molokai species; first antennal segment distinctly multiannulate; middle lobe of pronotum strongly convex, rather bulbous as seen from side.....**paludicola** (Kirkaldy).
Oahu species; first antennal segment not obviously annulate; middle lobe of pronotum moderately convex.....
.....**kaohinani** (Kirkaldy).

Nabis blackburni White (figs. 55, a; 58).

Nabis blackburni White, 1878:373.

Reduviolus blackburni (White) Kirkaldy, 1902:155, in part; 1909:60, figs. 2, 11, 16, 17.

Endemic. Kauai, Oahu (type locality ?), Molokai, Lanai, Maui, Hawaii. (Kirkaldy lists it from Laysan, but the specimens I have seen from the leeward islands are the often-confused *capsiformis*.)

Hostplants: *Acacia koa, Campylotheca, Deschampsia australis,* ferns, grasses, *Lythrum, Metrosideros, Raillardia, Scaevola,* sedges, *Sophora, Styphelia,* sugarcane, *Suttonia, Verbena.*

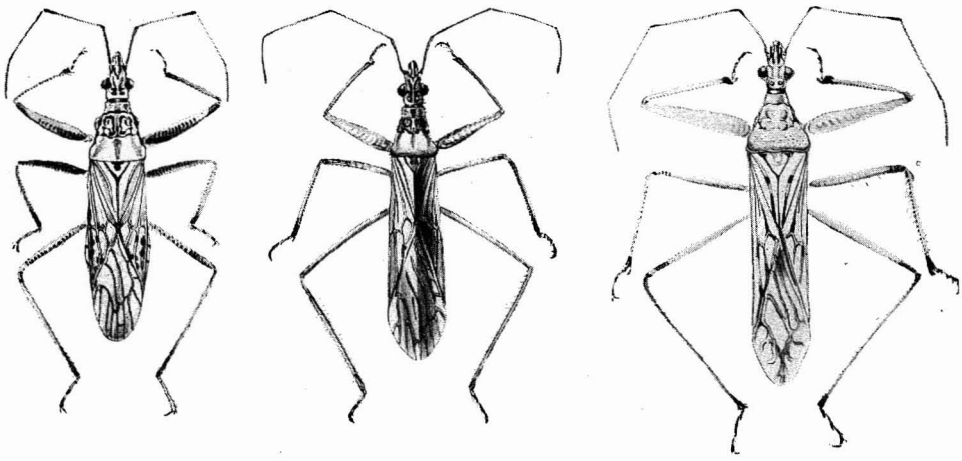

Figure 58—*Nabis blackburni* White, left; *Nabis capsiformis* Germar, middle; *Nabis giffardi* Van Duzee, right. (Abernathy drawings.)

The holotype is presumably in the Perth Museum of Natural Sciences, Scotland.

There has been a surprising amount of confusion regarding this species. It has been taken frequently for *capsiformis,* and many records listed as for this species really belong to *capsiformis.* The species are quite distinct, however, and there is little excuse for not recognizing them, at least in the male sex. *N. blackburni* is a darker insect with dark markings on the tegmina, and the male genital claspers are conspicuously different from those of *capsiformis.* The claspers of *blackburni* have an easily seen, prominent, tooth-like lobe on the ventral edge at about the middle, but in *capsiformis* the ventral edge is continuously arcuate from the subbasal constriction. These differences are shown in the accompanying illustrations and serve to separate the species at a glance.

Nabis blackburni is the commonest and most widespread of our native nabids. It has been collected from one end of the main islands to the other. It is most abundant at higher elevations, but it has been collected in the lowlands also.

This species is remarkable for its tendency toward variation in the development of its tegmina and wings. Kirkaldy (1909:60) and Perkins (1913:cxcvi) both remarked on this. Perkins noted that it

> differs from all the others, in having brachypterous and macropterous forms, as well as somewhat intermediate conditions. It was described, no doubt from macropterous examples, by White... there being no brachypterous specimens in Blackburn's collection. Blackburn's specimens were such as are usually found in drier localities or at lower elevations; truly brachypterous forms inhabit wetter localities or higher elevations in the mountains. I have taken some pains to observe this species at high elevations above 4000 ft. in the mountains, where I have seen it breeding in numbers amongst low sedges. In the most brachypterous form the membrane is much reduced in the female, the tegmina not quite covering the abdomen, while the wings are much shorter, though extending somewhat beyond the middle of the abdomen.

Kirkaldy (1909:60) described the nymph as follows: "The nymph, when living, is dark, purplish-brown above, more or less variegated; scutellum yellow behind.

Beneath pale yellow, abdomen apically more or less fuscate. Femora annulate near the apex. Pleurites spotted with reddish."

Kirkaldy (1907:156) considered this to be an Australian immigrant, but I do not believe that this claim has been substantiated by other workers.

Nabis capsiformis Germar (figs. 55, b; 58).

Nabis capsiformis Germar, 1837:132.

Nabis innotatus White, 1877:112. Blackburn, 1888:352, in part. Kirkaldy, 1907:156. Synonymy by Reuter, Mem. Soc. Ent. Belgique, 15:114, 1908. (I have not seen this reference.)

Reduviolus capsiformis (Germar), of authors.

Reduviolus blackburni, not of White, misidentification by Kirkaldy, 1902:155, in part; 1909:59, fig. 1. The *Reduviolus innotatus* (White) of Kirkaldy, 1902:154, pl. 5, fig. 32, does not apply to this species (see *kahavalu*). Swezey, 1905:234, pl. 18, figs. 1–4, bionomics. Van Duzee, 1917:280, gives extra-Hawaiian synonymy.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii, Nihoa, French Frigate Shoal, Lisiansky, Pearl and Hermes Reef, Laysan, Midway, Ocean, Johnston.

Immigrant. Now nearly cosmopolitan. Considered to be an Australian species by some workers. First recorded from Hawaii by White in 1877. It is widespread among the Pacific islands.

Hostplants: alfalfa, Bermuda grass, *Cyperus,* grasses, potato, sugarcane, taro, various garden and truck crops.

Hosts: sugarcane aphis and leafhopper, in addition to a large number of other similar insects not specifically identified. It has also been reported to feed upon honeydew from the sugarcane leafhopper.

Parasite: *Polynema reduvioli* Perkins (Hymenoptera: Mymaridae), considered to be an immigrant species. It lays one egg in each bug egg attacked.

Nabis capsiformis, a common, widespread species, resembles the native *blackburni,* with which it is commonly confused. It is a paler, more uniformly colored species with conspicuously different male claspers, as illustrated in figure 55, b. It is principally a species of the drier areas and the lowlands, and even finds bunch grass on coral atolls to its liking. The eggs have been found inserted in the stems of grass and in the midribs of sugarcane leaves. Swezey (1905:235; under the confused name *blackburni*), noted that "A female in confinement deposited 15 eggs, singly, in an irregular row in a cane-leaf. Two of these hatched in 10 and 11 days respectively. The nymphs were slender, of a pale yellow color. They molted 5 times at intervals of about 5 days (3–7), and matured in 24 days."

Bryan (*Proc. Hawaiian Ent. Soc.* 8(2):237, 1933) reported that what he thought was this species "was found sucking blood from the baby, having raised three small welts on his neck."

China, in *Insects of Samoa* (1930:157) has the following to say:

The Samoan specimens agree very well with the type of the Hawaiian *R. innotatus* B. White, which is apparently teneral. Reuter has identified this species with the almost cosmopolitan *R. capsiformis* Germar. With this I am not entirely in agreement, for, although as pointed out by Reuter this species is very variable, it seems more than probable that several subspecies, at least, are involved. Apart from the question of pterygo-dimorphism, the Pacific Island forms differ markedly from the typical Mediterranean and South African form in the much smaller size of the membrane. The hind femur and the second antennal segment in the Samoan specimens are distinctly longer than in Hawaiian specimens, although the shape of the male parameres is the same.

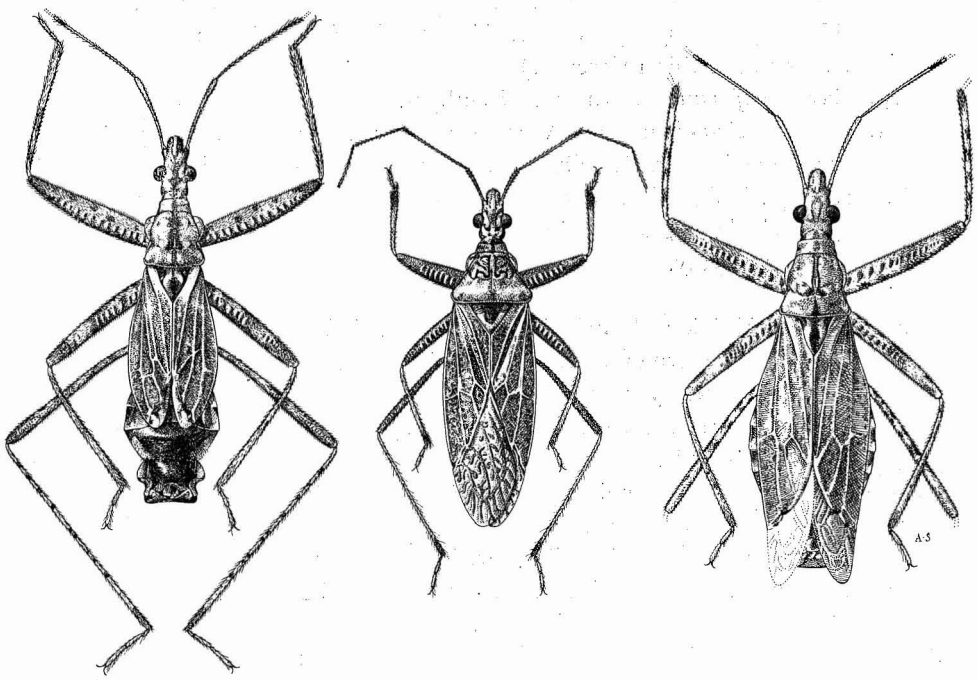

Figure 59—*Nabis curtipennis* Blackburn, drawn from the male holotype of *volcanicola* (Kirkaldy), left. *Nabis morai* (Kirkaldy), female holotype, middle. *Nabis nubicola* (Kirkaldy), holotype male, right. (Drawings made at the British Museum of Natural History by Smith.)

Nabis curtipennis Blackburn (figs. 55, e, f, m; 57, a; 59).

Nabis (?) *curtipennis* Blackburn, 1888:353.

Reduviolus curtipennis (Blackburn) Kirkaldy, 1902:157, incorrectly synonymized under *lusciosus,* pl. 5, figs. 34, 34a; 1908:193; 1909:68; 1910:549.

Reduviolus volcanicola Kirkaldy, 1908:193, type in the British Museum. New synonym.

Endemic. Hawaii (type locality: near Waimea).

Hostplants: tree ferns, in ground litter.

This brachypterous species confused Kirkaldy. When he had Blackburn's type

in hand he considered it to be a synonym of *lusciosus*. Later he ignored his earlier observations and gave it a new name. I have before me Blackburn's holotype (now in the Bishop Museum collection) and a series of specimens taken by Perkins, some of which were examined by Kirkaldy, and the above synonymy is indicated. Mr. China also found that the holotype of *volcanicola* runs to this species in the key.

The dorsum of the abdomen has a pinkish color in the male, but it tends to dry dark in the female. The femora and tibiae are annulated, the tibiae less darkly than the femora.

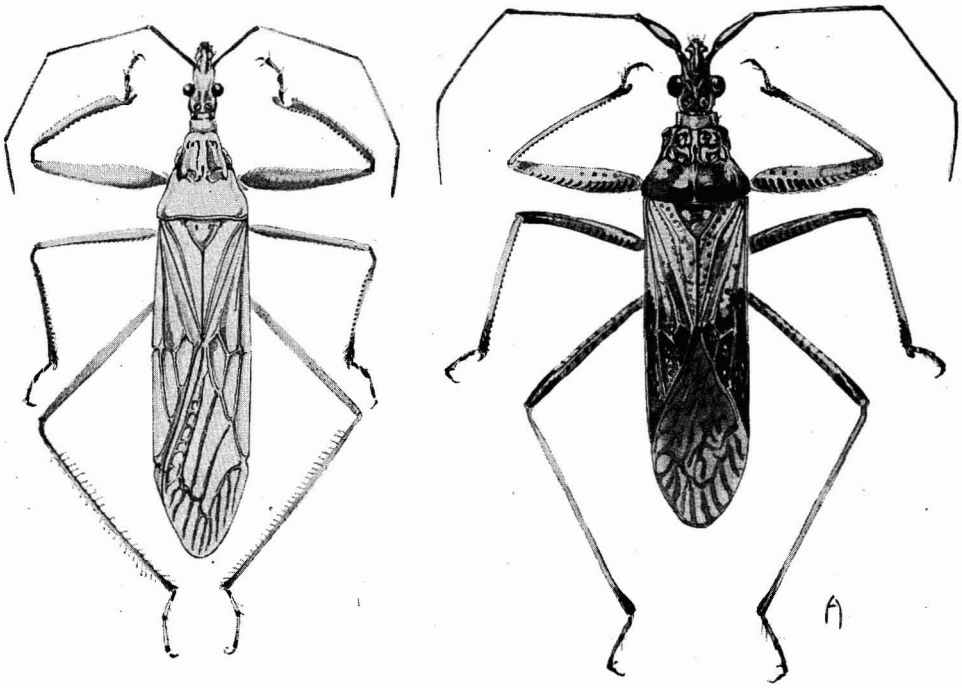

Figure 60—*Nabis kahavalu* (Kirkaldy), left. *Nabis kerasphoros* (Kirkaldy), right. (Abernathy drawings.)

Nabis giffardi Van Duzee (figs. 55, c; 58).

Nabis giffardi Van Duzee, 1936:226.

Endemic. Hawaii (type locality: South Kona Road, 1,900 feet).

This is a pale form which has a variable amount of dark coloring on the dorsum. The holotype is in the Bishop Museum.

Nabis kahavalu (Kirkaldy) (figs. 55, d; 60).

Reduviolus kahavalu Kirkaldy, 1907:156; 1909:61; 1910:546.

Misidentified as *Reduviolus innotatus* (White) by Kirkaldy, 1902:154, pl. 5, fig. 32.

Reduviolus (subgenus *Nesomachetes*) *kahavalu* (Kirkaldy) Kirkaldy, 1908:190.

Endemic. Hawaii (Kirkaldy designated no type locality, but his specimens came from Kona and Kilauea. His Oahu record was in error, as he pointed out in 1909:61).

Hostplants: attached to *Sophora chrysophylla* ("mamani"), *Dodonaea* (accidental ?).

This is perhaps the palest of all of our species. The tegmina and wings are nearly clear on some examples so that the abdomen partly shows through. It is a striking green color in life, but dries to whitish, yellowish and pale brownish. Some examples have a decided iridescent cast to the tegmina and wings. The male claspers are peculiar and diagnostic (see fig. 55, d). It occurs from 4,000 to 8,000 feet or higher where its leguminous hostplant is found. It is a splendid species in life.

There is a series of cotypes in the Bishop Museum's share of the *Fauna Hawaiiensis* collection; the holotype is in the British Museum.

The records by Bryan and Swezey (1926:80) listing the species from Nihoa and Wake Islands are in error. Their Wake Island specimen is evidently a nymph of *capsiformis,* but the Nihoa Island material represents a fine new species.

Nabis kaohinani (Kirkaldy) (figs. 55, g, k; 61).

Reduviolus kaohinani Kirkaldy, 1909:68.

Endemic. Oahu (type locality: Kaumuohonu).

The only known specimen of this very short-winged species is the male holotype collected by Swezey which is now in the collection of the Hawaiian Sugar Planters' Association Experiment Station.

Kirkaldy recorded the locality data as "Oahu, Tantalus, about 2000 ft." in his original description. His record is erroneous, for the label on the holotype reads "Oahu, Kaumuohonu, Jun. 08. O.H.S."

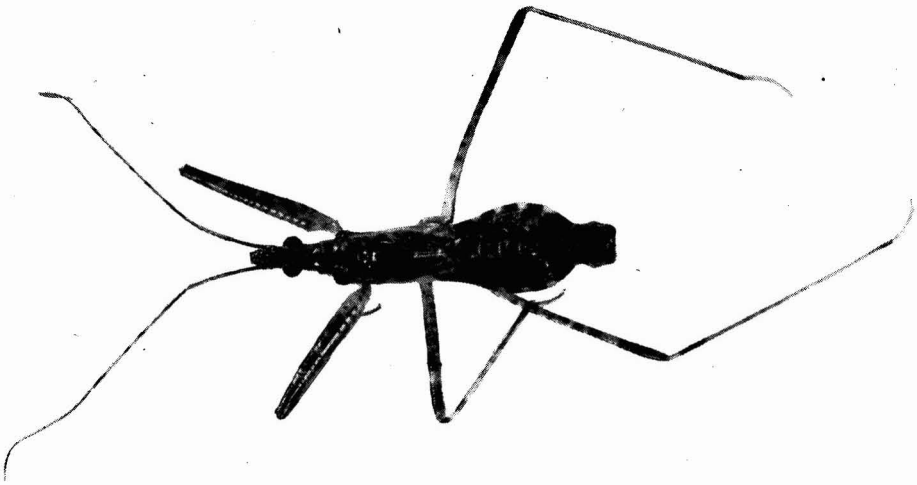

Figure 61—*Nabis kaohinani* (Kirkaldy), holotype male.

On the holotype, the tegmina are as long as the pronotum plus the "neck" of the head, their three veins are prominent, and the tiny membrane is obliquely placed on their inner hind edges.

Nabis kerasphoros kerasphoros (Kirkaldy) (figs. 55, h; 60).

Milu kerasphoron Kirkaldy, 1907:248.

Reduviolus rubritinctus, misidentification by Kirkaldy, 1902:157, pl. 5, fig. 33.

Milu kerasphoros Kirkaldy, 1908:194.

Reduviolus kerasphoros (Kirkaldy) Kirkaldy, 1909:65.

Reduviolus (subgenus *Milu*) *kerasphoros* (Kirkaldy) Kirkaldy, 1910:549.

Endemic. Oahu (no type locality designated by Kirkaldy).

Hostplants: *Metrosideros, Acacia koa* (?).

This is a large, fine, reddish species which differs from all other Hawaiian *Nabis* in having a pair of upturned, conspicuous, cephalic horns, one on either side of the median line of the head in front of the antennae. The first segment of the antennae is noticeably thickened and somewhat spindle-shaped. In the typical form, the tegmina are yellowish as far as the apex of the clavus, thence mostly reddish. This bicolored pattern is striking.

Cotypes are in the Bishop Museum, and the holotype is in the British Museum.

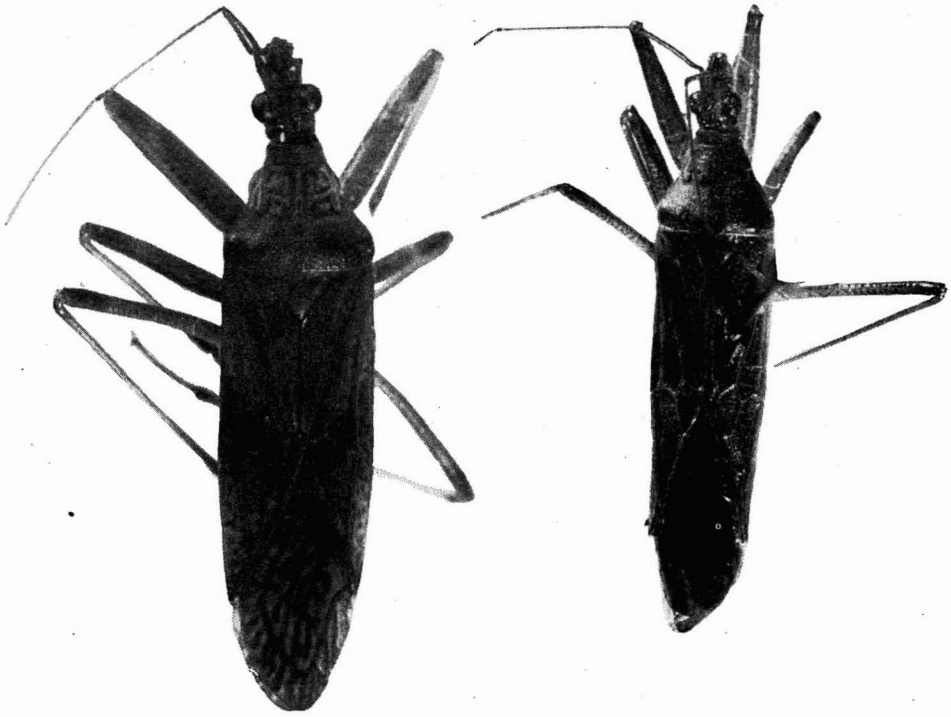

Figure 62—*Nabis kerasphoros purpureus* (Kirkaldy), left. *Nabis rubritinctus* Blackburn, right.

Nabis kerasphoros purpureus Kirkaldy (fig. 62).

Nabis kerasphoros variety *purpureus* Kirkaldy, 1908:195.

Endemic. Oahu (type locality: Palolo).

This is a color form in which the tegmina are not bicolored but are entirely reddish (excepting the membrane).

The holotype is in the Hawaiian Sugar Planters' Association Experiment Station collection.

Nabis koelensis Blackburn (figs. 55, i; 63).

Nabis Koelensis Blackburn, 1888:352.

Reduviolus arrogans Kirkaldy, 1908:191. New synonym.

Reduviolus subrufus, in part by misidentification by Kirkaldy, 1902:156.

Reduviolus koelensis (Blackburn) Kirkaldy, 1909:63.

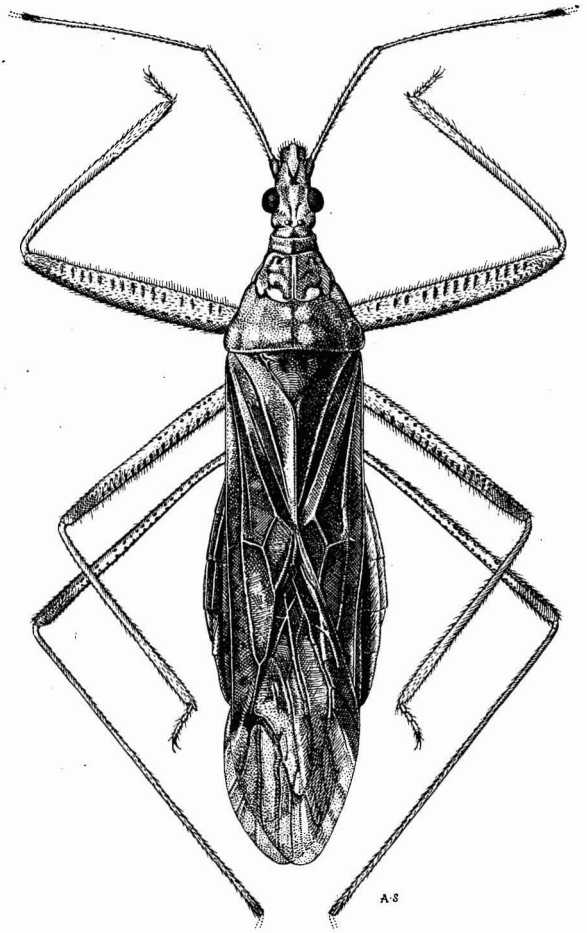

Figure 63—*Nabis koelensis* Blackburn. Drawn at the British Museum of Natural History by Smith from the holotype of *arrogans* (Kirkaldy).

Endemic. Molokai, Lanai (type locality: near Koele).

Hostplants: *Coprosma, Metrosideros* (?).

The unique female holotype, now in the Bishop Museum, was so badly damaged before it came to us that accurate identification is difficult. I have examined a good series of examples taken by Usinger on Lanai which I believe to be Blackburn's species and which may be topotypes.

I believe that this is a near relative of *oscillans* and that it may be only a geographical subspecies. Both this species and *oscillans* are variable in color and certain other features, but the male claspers appear to display a constant difference (fig. 55, i).

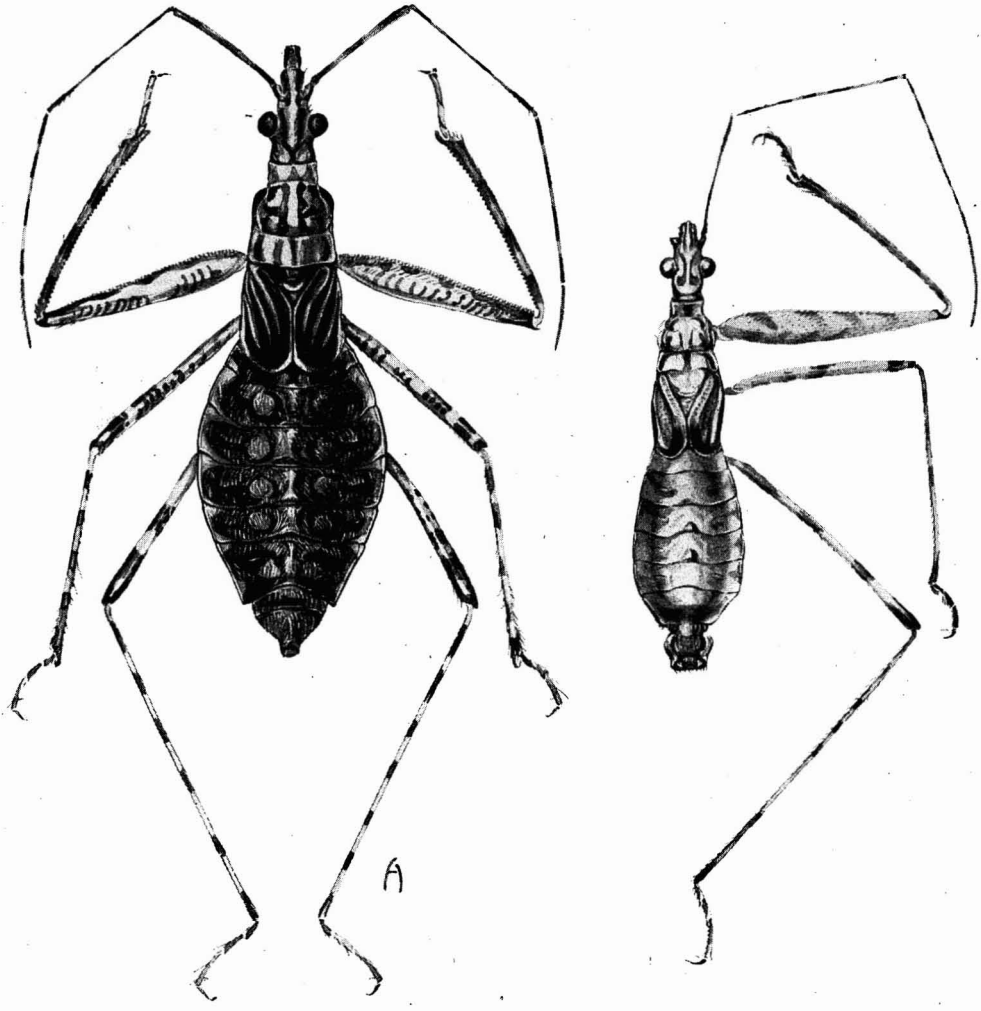

Figure 64—*Nabis lolupe* (Kirkaldy), female and male. (Abernathy drawings.)

The references of Kirkaldy to examples from Oahu are in error, for his specimens, at least in part, represent a new species. His figure (1909:63, fig. 6) was not made from an example of *koelensis*.

I have before me two examples collected by Usinger on Molokai which appear to be Kirkaldy's *arrogans*. These are identical with the Lanai specimens of *koelensis*, including the structure of the characteristic genital claspers, and, therefore, Kirkaldy's *arrogans* is reduced to synonymy. It will be advisable, however, to check his holotype.

Perkins (1912:728) thought that this might be a synonym of *subrufus*, but it is quite distinct. However, the species may be confused or mixed in some collections.

Nabis lolupe (Kirkaldy) (figs. 55, j, 1; 64).

Reduviolus lolupe Kirkaldy, 1908:193; 1909:68, fig. 9; 1910:549.

Endemic. Kauai (type locality: undetermined).

Hostplant: *Cyrtandra*.

Kirkaldy's unique female holotype, which is in the British Museum, apparently has no definite record attached to it, and he gave as the type locality "Kauai ? Molokai ?." I have examined two females and a male from Kauai which are believed to be this species. A pair of these is illustrated here in figure 64. The male was taken by Swezey at Kinana, August 2, 1935, one female was collected by Usinger at Kalalau Lookout, December 29, 1935, and the other female was taken by me in the northeast Alakai Swamp region, July 21, 1937. The male is a much more slender insect than the female, and it is paler. The annulations on the antennae and legs vary in intensity. The middle vein on the tegmina of the male is less well marked than on the female.

Nabis lusciosus White (figs. 56, a, b; 65).

Nabis (?) *lusciosus* White, 1877:112; 1878:366.

Reduviolus lusciosus (White) Kirkaldy, 1902:157, pl. 5, fig. 35 (fig. 34 is *curtipennis*); 1908:192; 1909:65.

Nesotyphlias lusciosus (White) Kirkaldy, 1907:155.

Reduviolus monticola Kirkaldy, 1908:192. Synonymy by Kirkaldy, 1909:66.

Endemic. Oahu (no type locality given by White).

Hostplants: grasses, ferns, *Acacia koa, Metrosideros, Pipturus, Straussia*.

Of all the flightless species, this is the one most abundantly represented in collections. It is confined to Oahu, but there are several other species from Kauai, Molokai, Maui and Hawaii which are closely allied to it and which have been confused frequently with it. These species are closely and confusingly similar in the female sex. Some of them are undescribed. I have seen more than one species in this complex on Oahu, and Kirkaldy included more than one Oahu species under

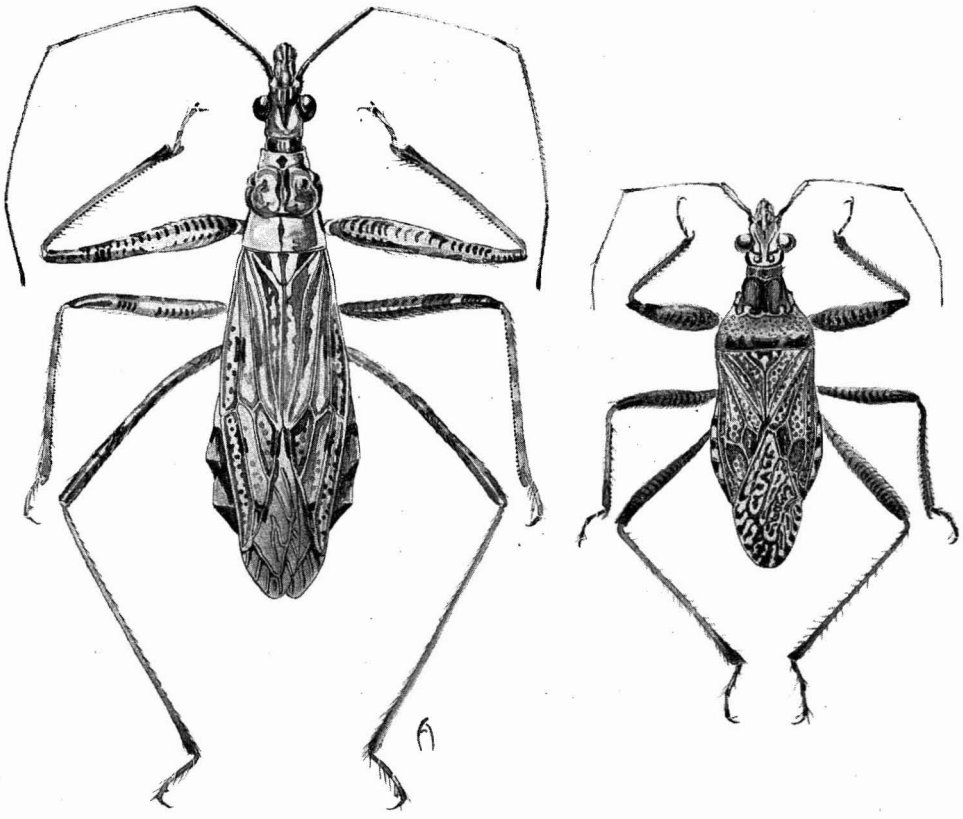

Figure 65—*Nabis lusciosus* White, left. *Nabis nubigenus* (Kirkaldy), right. (Abernathy drawings.)

this name in the material he studied. The records in literature contain numerous errors resulting from the misidentification of the species of this group.

Although the hind wings are obsolescent (about 0.5 mm. long) and the tegmina are distinctly modified, the latter organs extend to the apex of the abdomen and are not abbreviated as they are on many of the flightless forms.

Kirkaldy saw the holotype in the Perth Museum.

This species mainly frequents grass and low herbage and I have seen it preying upon the nymphs of the common, terrestrial native cricket *Paratrigonidium pacificum* Scudder on Mount Tantalus, Honolulu.

Nabis morai (Kirkaldy) (figs. 56, f; 59).

Reduviolus morai Kirkaldy, 1902:155, pl. 5, fig. 39 (fig. 39a is not of this species); 1908:191; 1909:62; 1910:547.

Endemic. Kauai (type locality: high plateau, 4,000 feet).

This species, although it is restricted to Kauai, has been confused with other species, and it has been recorded in literature erroneously as occurring on other islands. Kirkaldy listed it originally from Kauai, Oahu, Molokai, Lanai and Maui without designating a type locality. Later (1908:191) he gave the type locality as Kauai. I have delimited it further, as noted above, from data from cotypes in the Bishop Museum. The holotype is in the British Museum.

It is a dark form with numerous, large, shallow, dark punctures on the tegmina. It approaches *nubigenus* (with which it was confused by Kirkaldy) although it is not quite so short and stout as that species.

Nabis nesiotes (Kirkaldy).

Reduviolus nesiotes Kirkaldy, 1909:65, fig. 12.

Endemic. "Hawaiian Isles (? locality)."

This was described from "fragments of a single female, and . . . described . . . only because it appears to me not to be conspecific with any other form; and to be worthy of record on account of the wing reduction." (Kirkaldy, 1909:65.)

The type is in the British Museum. I do not know how it can be recognized from Kirkaldy's notes and lack of an insular record. He said (1909:65), "This has the general appearance of a short-winged *blackburni,* but the female abdomen is more like that of *subrufus.* It is larger and darker than *blackburni.* . . . In brachypterous *blackburni* the wing-venation is nearly the same as that of the normal form, except that it is shortened, but in *nesiotes,* the wing-venation is much reduced." Mr. China has kindly placed it in the key. The broken type is in too poor a condition to draw, according to the artist.

Nabis nubicola (Kirkaldy) (figs. 57, b; 59).

Reduviolus nubicola Kirkaldy, 1909:67.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Mr. China has examined the holotype in the British Museum for me and has sent the following note: "The unique type is a male. It is not darker or more reddish brown than *N. lusciosus.* It is a very striking species with long pointed membrane on the relatively short (brachypterous) elytron. The male clasper is very striking, being large and truncated at apex instead of pointed as in *N. lusciosus* and many other species." Obviously, there is some confusion here. Kirkaldy's original description reads as follows: "Of this I have not seen a male; the female differs from *lusciosus* by the lateral margins of the pronotum being more divergent behind, and the fore lobe more convex. The membrane is shorter and more divergent interoapically, lateral margins straight or slightly emarginate. The basal segment of the antennae has faint fuscous annulations. Length, 8 mill. Hab. Maui, Haleakala (5000 ft., Perkins)." Perhaps the words "male" and "female" in the description were transposed by error.

There is a pair of specimens in the Bishop Museum's share of the *Fauna Hawaiiensis* material under this name, and they come from the type locality. They were apparently determined by Perkins, but they represent a new species.

Nabis nubigenus (Kirkaldy) (figs. 56, g–i; 65).

Reduviolus nubigenus Kirkaldy, 1908:191; 1909:63, pl. 1, fig. 15; 1910:547. (Kirkaldy, 1902, pl. 5, fig. 39a applies to this, not *morai.*)

Endemic. Molokai, Maui, Lanai (type locality: Haalelepakai).

Hostplant: *Metrosideros.*

I have examined cotypes from Maui, Molokai and Lanai, in addition to a series of specimens taken in more recent years on Maui and Lanai. Kirkaldy thought that it also came from Oahu, but when he described the species as distinct from *morai,* with which he had confused it originally, he stated that he was not sure of the Oahu record. No specimens of such a species from Oahu have come to my attention, and I believe that the record had best be dropped, unless conclusive data to the contrary are assembled.

There are slight differences in the form of the male genital claspers among the specimens from Molokai, Lanai and Maui. I have figured one from each island. There is only one example of the Molokai form (a Kirkaldy cotype) available to me. As illustrated, the clasper of the Molokai specimen has the more divergent shape. Perhaps a series of examples would show more intergradation. The Molokai and Maui specimens might possibly be considered forms of the species, but on the basis of present knowledge, I believe that they are too closely allied to be considered species.

This is our shortest and stoutest volant *Nabis,* and it is a distinctive form. The tegmina have a purplish or reddish tinge, and, like *morai,* they have many conspicuous, shallow, dark punctures. Usinger (1936:218) noted that the series of specimens collected by him on Lanai "exhibits striking sexual dimorphism, the males in every case having a ground color of mottled or spotted dark gray while the females are decidedly lighter with a ferrugineous ground color." His specimens (in the collection for more than 10 years) now do not show such striking differences in color, and the sexes are more nearly uniform in coloration. The series of examples from Maui have indications which show that in life they had a similar dichromatism.

Nabis oscillans Blackburn (figs. 56, j; 66).

Nabis oscillans Blackburn, 1888:352.

Endemic. Hawaii (type locality: Mauna Loa, 4,000 feet).

Hostplants: *Metrosideros* (preferred host), *Santalum* (sandalwood).

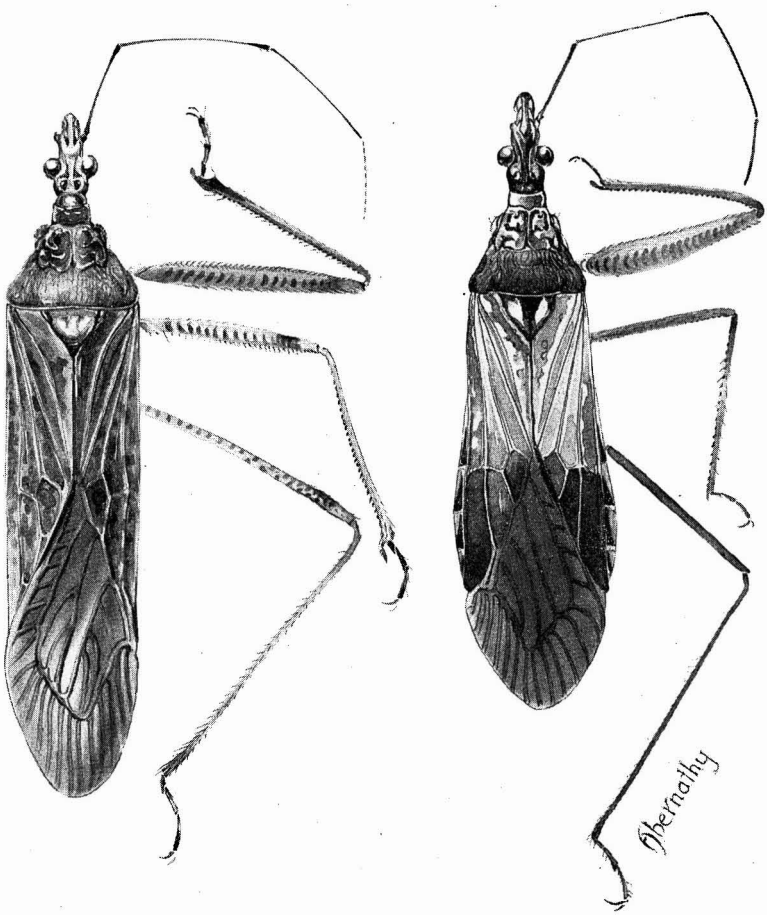

Figure 66—*Nabis oscillans* Blackburn, left. *Nabis sharpianus* (Kirkaldy), right. (Abernathy drawings.)

Blackburn's type and paratype are now in the Bishop Museum. Although the holotype is not in perfect condition, it is not in such bad condition as one would expect from reading Kirkaldy's remark in his 1902 report.

Kirkaldy (1902:156) placed this species as a synonym of *subrufus*; in 1908 (p. 191) he listed it separately; in 1909 (p. 64) he again placed it under *subrufus*; and in 1910 (p. 547) he again separated it, stating that he was not sure that he knew the species.

This species is an ally of *subrufus,* which it closely resembles. However, I feel that it is a distinct Hawaii representative of the Oahu *subrufus*. The claspers are different and none of a long series of specimens examined has annulate tibiae.

Mr. China informs me that there are no specimens under the name *oscillans* in the British Museum.

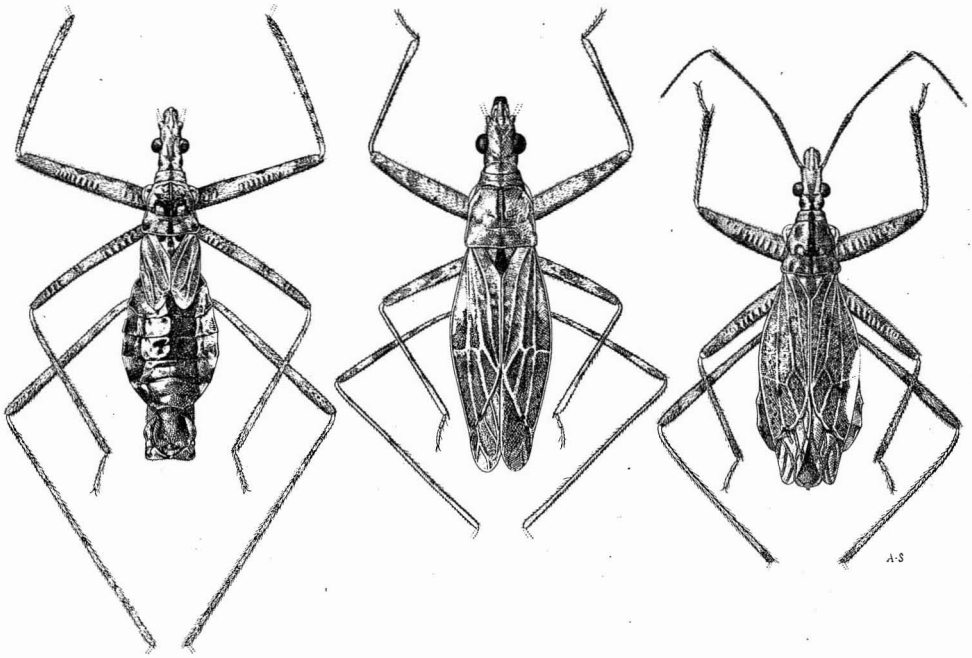

Figure 67—*Nabis paludicola* (Kirkaldy), holotype male, left. *Nabis pele* (Kirkaldy), holotype male, middle. *Nabis procellaris* (Kirkaldy), holotype female, right. (Drawn at the British Museum of Natural History by Smith.)

Nabis paludicola (Kirkaldy) (figs. 57, c; 67).

Reduviolus paludicola Kirkaldy, 1908:193; 1909:68; 1910:549.

Endemic. Molokai (type locality: 4,000 feet).

Little is known about this species. What may be Kirkaldy's female cotype is in the *Fauna Hawaiiensis* collection at the Bishop Museum. The specimen is in a fragmentary condition. The entire body anterior to the scutellum is wanting, and only the middle pair of legs remains. Thus, the most important features mentioned by Kirkaldy are missing from our example. However, the male holotype, which is in the British Museum, is figured here, and the illustrations display the distinctive features of this very short-winged, remarkable species.

Nabis pele (Kirkaldy) (figs. 56, c; 67).

Reduviolus pele Kirkaldy, 1909:67.

Endemic. Hawaii (type locality: Olaa).

Hostplants: *Cibotium* fern, *Metrosideros* (host of holotype).

There is a single male example in the Bishop Museum's *Fauna Hawaiiensis* material. It resembles closely a small *lusciosus*. The holotype, illustrated here, is in the British Museum. Mr. China says that the holotype bears a red type label "*konanus* Kirk." and also a label written by Perkins, "*R. pele*. Type wrongly labeled *konanus* by Kirkaldy."

Nabis procellaris (Kirkaldy) (figs. 56, d; 67).
Reduviolus procellaris Kirkaldy, 1908:193; 1909:67; 1910:548.

Endemic. Molokai (type locality: 4,500 feet).
Hostplant: *Freycinetia.*
This belongs to the *lusciosus* complex and resembles *lusciosus.* The male clasper with its peculiar, forward-projecting tooth on the lower margin is conspicuously different from that of *lusciosus,* as the illustrations show.
The female holotype is in the British Museum, and an illustration of it is included here. I have before me one male and two females from Kainalu, Molokai. The cells of the corium and the membrane are obviously shorter than those of *silvicola* which may easily be confused with this species in the female sex, at least.
Kirkaldy described this as a new species in 1908. In his 1909 paper, he apparently overlooked the fact that he had already described the species, for he described it as new again. In 1908 he stated that his type was a female, but in 1909 he considered it to be a male. China writes of the type in the British Museum that it "is a female, probably a brachypterous form of *N. lusciosus* B. White. Very similar indeed to *N. nesiotes* Kirk."

Nabis rubritinctus Blackburn (figs. 56, k; 62).
Nabis rubritinctus Blackburn, 1888:351.
Milu (?) *rubritinctus* (Blackburn) Kirkaldy, 1908:195.
Reduviolus rubritinctus (Blackburn) Kirkaldy, 1909:65.
Reduviolus (subgenus *Milu*) *rubritinctus* (Blackburn) Kirkaldy, 1910:549.
Reduviolus subrufus variety *melemele* Kirkaldy, 1909:64. New synonym.

Endemic. Maui (type locality).
Hostplants: *Acacia koa, Coprosma.*
This species has been known only from the unique type which is now in the Bishop Museum. It was damaged by insect pests before Perkins obtained it from the Blackburn collection, but it is in good enough condition to be recognizable, for the damage has been confined to the legs and antennae of the left side, the right wing and tegmen and the basal part of the abdominal venter. In Kirkaldy's 1902 paper (p. 93) he stated that Blackburn had loaned him the type for examination, but in 1910:549, he said that he had not seen it.
Blackburn (1888:352) said that "A single male of this handsome insect occurred on Maui, but I regret to find that I have no record of the exact circumstance of its capture." He misidentified the type as a male; it is a female. During this study, I have located two examples of this species in the Bishop Museum collections—one, a male from Hana, the other, a female from Kipahulu—and a pair in the Hawaiian Sugar Planters' Association Experiment Station collection from Olinda (all East Maui localities). The female from Kipahulu is colored as is the female holotype, with the posterior tegminal veins reddish. The male from Hana, however, has the entire tegmina red. The Olinda female lacks the reddish coloring.

The first antennal segment is heavier than the second, but it is not developed as in *kerasphoros* as Kirkaldy assumed it was.

This species bears a great resemblance to *sharpianus* from Kauai, to which I feel it is related.

I had placed Kirkaldy's variety *melemele* of *subrufus* as a synonym of this species on the basis of literature alone, but the type of *melemele* was checked by Mr. China at the British Museum. He found that it ran to this species in my key.

Mr. China sends information that specimens in Kirkaldy's series under this name at the British Museum are *kerasphoros.*

Nabis sharpianus (Kirkaldy) (fig. 66).

Reduviolus sharpianus Kirkaldy, 1902:156, pl. 5, fig. 36; 1908:191; 1909:64.

Endemic. Kauai (type locality: high plateau, 4,000 feet).

This is the brightest colored, most showy of the Hawaiian species. Its striking color pattern is characteristic. The tegmina are yellow as far back as the apex of the clavus, thence red. This pattern is duplicated in *kerasphoros,* but it is not as bright in that species.

I have never seen a male of this handsome insect, and Kirkaldy reported the same results from the series he examined. The holotype is in the British Museum.

Nabis silvestris (Kirkaldy) (figs. 56, n, o; 68).

Reduviolus silvestris Kirkaldy, 1908:194; 1909:67; 1910:459.

Endemic. Kauai (type locality: 4,000 feet).

Hostplants: *Acacia koa, Alyxia, Cibotium.*

This species is a Kauai representative of the Oahuan *lusciosus,* to which it is closely allied. It is smaller than typical *lusciosus,* and the male claspers are different, as the illustrations will show. Kirkaldy said that the tegmina are much shorter than on *lusciosus* and do not quite reach the apex of the abdomen. This statement appears to be true only for gravid females with distended abdomens. The series of specimens I consider to be this species includes both males and females. In all of these the tegmina exceed the abdomen except in one female whose abdomen is inflated. I have not seen the type, which is in the British Museum.

Nabis silvicola (Kirkaldy) (fig. 68).

Reduviolus silvicola Kirkaldy, 1908:192; 1909:66; 1910:548.

Endemic. Molokai (type locality not designated further).

Hostplant: *Freycinetia.*

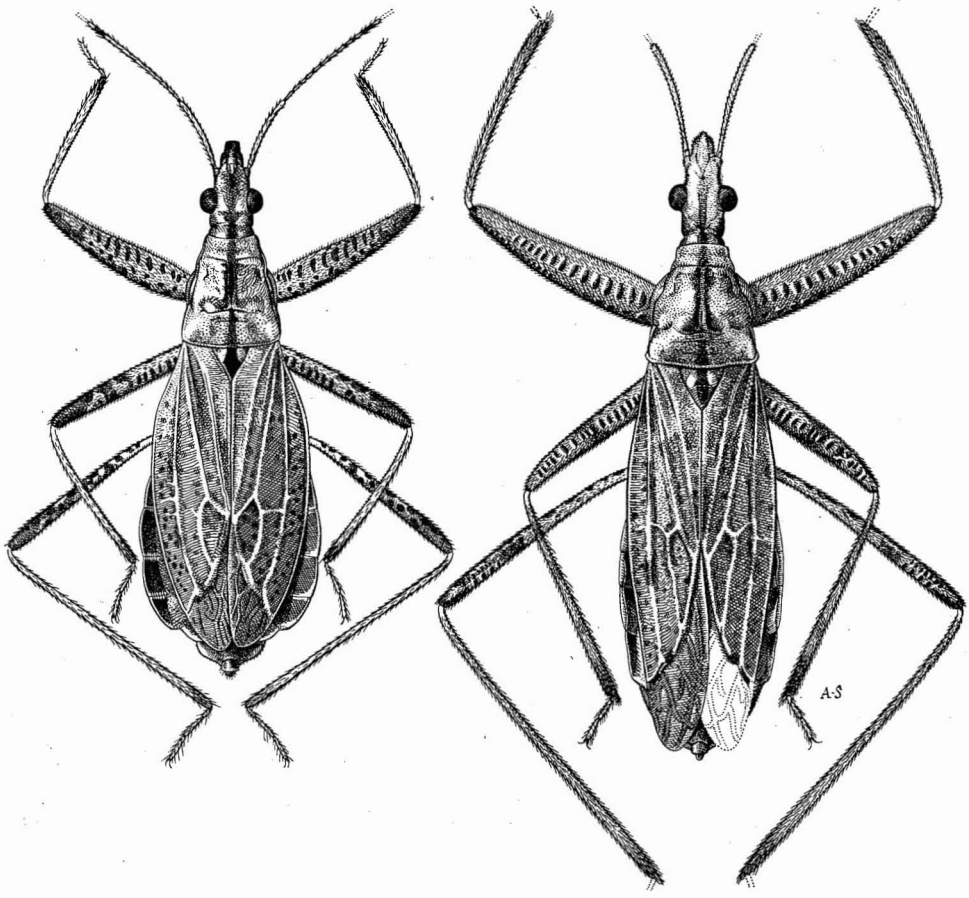

Figure 68—*Nabis silvestris* (Kirkaldy), holotype female, left. *Nabis silvicola* (Kirkaldy), holotype female, right. (Drawn at the British Museum of Natural History by Smith.)

The female holotype of this species is in the British Museum. Kirkaldy's original description "Scarcely to be distinguished from *lusciosus,* but the membranal venation is different and the ocelli more distinct. Length female 10½ mill." is worthless. There is considerable variation in the membranal venation and development of the ocelli in *lusciosus.* In 1909 (p. 66) he stated that "This is doubtfully valid, only a single female being known, but it is more elongate than *lusciosus,* and the pronotum seems proportionately longer, especially the median lobe." There are four females before me which I believe are this species. Two of them were taken by Perkins at 3,000 feet, November, 1902; one by A. F. Judd at McVeigh's, 3,500 feet, July 28, 1925; and the other by E. H. Bryan, Jr., at Kainalu, 2,000–3,000 feet, July 26, 1927, from *Freycinetia.* Although there is some variation in the length of the apical cells of the corium and the length of the membrane, all of these examples have these parts distinctly longer than those of *procellaris.* The illustrations show

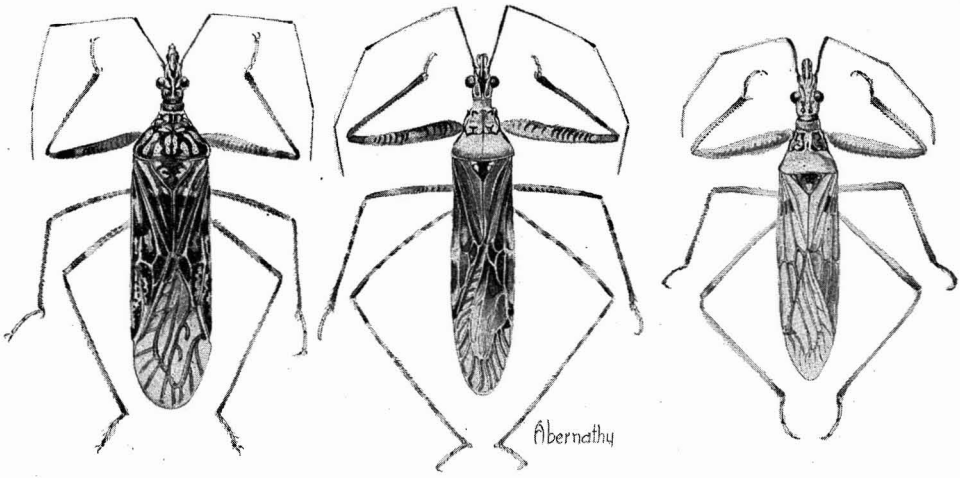

Figure 69—*Nabis truculentus* (Kirkaldy), left. *Nabis subrufus* White, middle. *Nabis tarai* (Kirkaldy), right. (Abernathy drawings.)

these characters plainly. Judging from the small series at hand, *silvicola* is a somewhat larger species than *procellaris*. When the male of *silvicola* is discovered, it may be found to display some excellent differential characters.

Nabis subrufus White (figs. 56, 1; 69).

Nabis subrufus White, 1877:112; 1878:366.

Reduviolus subrufus (White) Kirkaldy, 1902:156, pl. 5, figs. 37, 37a (fig. 38 does not apply to this species); 1908:191; 1909:64; 1910:547.

Endemic. Oahu (exact type locality undetermined).

Hostplants: *Metrosideros, Cyrtandra* (accidental ?).

Much confusion exists in literature regarding this species, and Kirkaldy included several forms from several islands under its name. Typical *subrufus* is an Oahu insect whose tibiae are annulate and whose male genital claspers are formed as in the accompanying illustration. The coloration varies considerably. Most of the specimens I have examined have the rings on the tibiae so distinct that I can see them without the aid of magnification. It is one of our commonest species.

Nabis tarai (Kirkaldy) (figs. 56, m; 69).

Reduviolus tarai Kirkaldy, 1902:154; 1908:191; 1909:61.

Reduviolus kaonohiula Kirkaldy, 1908:192 (the unique female type is from Hawaii, and is now in the British Museum); 1909:62, in synonymy; 1910:548.

Reduviolus montivagus Kirkaldy, 1908:192.

Reduviolus tarai variety *montivagus* (Kirkaldy) Kirkaldy, 1909:62; 1910:548. New synonym.

Endemic. Kauai, Oahu, Molokai, Lanai (type locality), Maui, Hawaii.

Hostplants: *Styphelia* (*Cyathodes*), accidentally on other plants such as *Acacia koa.*

Among the native species, this species shares with *blackburni* the distinction of being widespread over the islands. It is somewhat variable, not only in color, but also in slight differences in the male genital claspers. However, these differences are not limited in kind to any one island or locality, but variations which occur at opposite ends of the main archipelago also occur in the same locality. The species resembles *blackburni,* but in the typical form it is decidedly reddish. Considerable fading in color takes place after death. The male claspers have a conspicuous notch in the ventral margin which is distinctive.

The male holotype is in the British Museum. Mr. China says that the unique female holotype of *kǫonohiula* is similar to the type of *tarai* but is slightly more robust. Mr. China also notes that the specimen labeled as type of *montivagus* in the British Museum is not that species, but it appears to be probably a male *sharpianus.* A note on it by Perkins states that it is not *montivagus* nor *tarai* and that the type should be a female. A mixup of labels must have occurred. The type of *montivagus* is lost.

Nabis truculentus (Kirkaldy) (figs. 56, e; 69).

Reduviolus truculentus Kirkaldy, 1908:191; 1909:63, fig. 13; 1910:547; (1902: 156, part of *subrufus,* and pl. 5, fig. 38).

Endemic. Oahu (type locality: Mount Tantalus region ["Honolulu Mountains"]).

Hostplant: *Pipturus* ("mamake").

This is a striking species because of its color pattern, as the illustration demonstrates. It can be distinguished from all other species at a glance. The holotype is in the British Museum; I have examined cotypes at the Bishop Museum.

Family **CIMICIDAE** (Latreille, 1804) Samouelle, 1819

The Bedbugs

Our single representative of this family may easily be distinguished from all other Hawaiian Heteroptera by the following set of characters: nocturnal, temporary ectoparasitic on man; body greatly flattened, coarsely setose throughout, rotund in lateral outline; flightless, hind wings absent, hemelytra reduced to small flaps; head retracted up to eyes in the shield-like pronotum, ocelli absent, antennae four-segmented, rostrum three-segmented, not surpassing fore coxae; tarsi three-segmented, claws without arolia.

This is a small family of bloodsuckers whose species are included in only a few genera. In addition to the species attacking man, others feed upon bats and others on birds. Some species are pests of pigeons and some cause serious trouble to poultry. It would be most unfortunate if additional species were imported to these islands.

Kirkaldy used this family name for the Pentatomidae and replaced it with Clinocoridae, but his action was caused by an error in the fixation of the genotype.

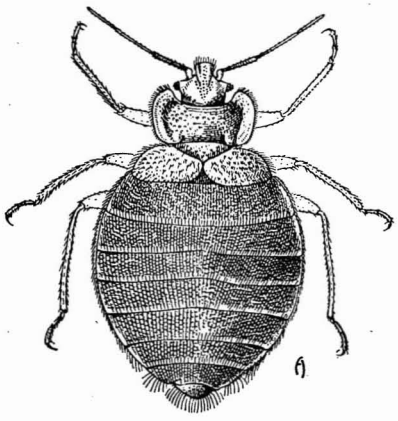

Figure 70—*Cimex lectularius* Linnaeus, the bedbug. (Abernathy drawing.)

Genus **CIMEX** Linnaeus, 1758:441

Cimex lectularius Linnaeus (fig. 70).

Cimex lectularius Linnaeus, 1758:441. Genotype. Fixed by Opinion 81 (1924) International Commission of Zoological Nomenclature.
Clinocoris lectularius (Linnaeus) of various authors.
Acanthia lectularia (Linnaeus), White, 1878:373.
Klinophilos lectularius (Linnaeus) Kirkaldy, 1899:219.

The bedbug (Hawaiian name: "uku-lio").

Evidently distributed throughout the islands.

Immigrant. Cosmopolitan. Established in Hawaii at an early date after the discovery of the archipelago by Captain Cook. Evidently first recorded from Hawaii in entomological literature by White (1878:373) as *Acanthia lectularia.*

There is little information regarding this pest in Hawaiian literature, but, in places, it is extremely abundant. It has increased with amazing rapidity since the beginning of World War II and has become more widespread than ever before. Fortunately, most cleanly householders do not know this pest. Because of the large numbers of troops and war workers stationed in the islands and the erection of

hundreds of barracks, one of the greatest bedbug exterminating problems in the history of the United States armed forces was said to have confronted medical officers here.

We have had no records of the tropical bedbug, *Cimex hemipterus* Fabricius, from Hawaii, although we might expect to find it here, for it is widespread in the tropics. It may be distinguished by its much less transverse prothorax (only about one-third or less broader than the breadth of the head across the eyes, or only slightly longer than the median line of the head and pronotum combined, whereas on *Cimex lectularius* the prothorax is nearly twice as broad as long and much broader than the median length of the head and pronotum combined), and by its darker color.

Bedbugs have pestered man for ages—even the ancient Greeks mentioned them. In spite of man's continued war against them, they are still pests of major importance. They are secretive, gregarious creatures which hide in cracks, crevices and crannies during the day but emerge at night to conduct nocturnal forays in search of blood meals from sleeping men. An individual female bug may lay from about 200 to 500 eggs in small batches over a period of a few weeks to several months. The eggs may hatch in about 10 days or less; the nymphs molt five times and may reach adulthood in six weeks. They can go long periods of time without food. They give off a characteristic musky odor which may be pronounced in rooms where they are abundant.

In spite of various reports, it apparently has never been proved that bedbugs are normal vectors of any human disease. Under experimental conditions it has been shown that bedbugs may transmit a few diseases, but they are not regarded as natural vectors.

When feeding undisturbed, a bedbug takes about five minutes or more to engorge fully. Individual hosts react differently to the bites. Some persons may be unusually sensitive and may become rather severely poisoned by the salivary secretions of the bug. Itchy welts, which may become secondarily infected through scratching, may result from their feeding. Much irritation and loss of sleep may accompany attacks. Continued, heavy feeding may result in various complications such as irritability, eye and heart disturbances, headache, anemia and nervousness.

Control. Inasmuch as bedbugs are so secretive in habit, they are frequently difficult to control. The best insecticide ever discovered for their control is DDT. A 5 percent solution sprayed over surfaces in infested areas will give excellent control for six or more months. Some older methods of control are as follows: In rooms and buildings that can be closed for fumigation, excellent control may be obtained by cyanide or methyl bromide fumigation. If these fumigants are not available, the burning of three pounds of sulfur per 1,000 cubic feet of space may be used. However, sulfur will tarnish metal and bleach fabrics and colored goods and may not be safe to use. In small rooms fumigation by the use of paradichlorobenzene crystals may be possible. In roughly constructed buildings such as temporary barracks, kerosene may be applied to the entire structure by the use of a long hose from a pump and a good spray nozzle. The kerosene may be forced

easily into all cracks and interspaces where the bugs may be hiding. (The moveable contents of such barracks must be removed to a fumigating vault, however.) Similar use may be made of the commercial sprays of pyrethrum in oil which may be applied with a hand sprayer. Various dusts such as pyrethrum, rotenone and sodium fluoride are useful if they can be brought in contact with the bugs.

Family **ANTHOCORIDAE** (Amyot and Serville) Dallas, 1852

Flower Bugs

A beneficial, predaceous group of small bugs with the following characters in common: head prolonged anteriorly; rostrum three-segmented, held away from lower surface of the head as in certain Reduviidae and Nabidae; antennae four-segmented; a pair of ocelli present or absent; hemelytra with cuneus and embolium well formed, separated by a distinct fracture; tarsi three-segmented, claws without arolia. The male genitalia are peculiar, and are closely similar to those of the cimicids; there is a single asymmetrical genital organ.

Occasionally, when passing through shrubbery on a hot day, one may be bitten by one or more of our immigrant species. These bugs feed on thrips, psocids and other small insects.

In addition to the genera and species listed hereinafter, I have examined undescribed new endemic forms—some of them brachypterous—and unidentified immigrant species.

The characters used to define the subfamilies and genera are not always as easily ascertained as we should like them to be. Therefore, two keys are given here, the first uses the accepted characters for the delineation of the subfamilies, and following that I have included a single key to all the genera of the family now recorded from the archipelago.

Key to the Subfamilies of Anthocoridae

1. Hind wings without a hamus in cell (our species are yellow or brownish-yellow with no extensive dark coloring excepting *Poronotellus*) ..... **Dufouriellinae.**

   Hind wings with a hamus in cell (all of our species with extensive dark coloring except *Lilia,* which has scutellum and most of pronotum, at least, dark) 2

2. Hairs on last two antennal segments very long, much longer than diameter of a segment (at least twice as great, up to four to six times as great in some forms) ..... **Lyctocorinae.**

   Hairs on last two antennal segments hardly longer than diameter of a segment ..... **Anthocorinae.**

KEY TO THE GENERA OF HAWAIIAN ANTHOCORIDAE

1. Hairs on last two antennal segments hardly longer than diameter of a segment.....**Orius** Wolff.
Hairs on last two antennal segments very long, much longer than diameter of a segment (at least twice as great, up to four to six times as great in some forms)..... 2

2(1). Ostiolar orifices curved cephalad..... 3
Ostiolar orifices curved caudad..... 4

3(2). Dorsal end of ostiolar orifice remote from anterior metapleural margin; fore femora armed with a small tooth near distal third; side margins of pronotum distinctly explanate; dorsum with at most only a few hairs, nearly bare .....**Lilia** White.
Dorsal end of ostiolar orifice extending nearly to anterodorsal corner of metapleura; fore femora unarmed; side margins of pronotum not explanate; dorsum conspicuously hirsute.....**Xylocoris** Dufour.

4(2). Rostrum short, not reaching fore coxae; fore femora multispinulose beneath, fore tibiae arcuate.....
.....**Physopleurella** Reuter.
Rostrum reaching or surpassing fore coxae; fore legs without such a combination of characters..... 5

5(4). Our species conspicuously, almost entirely, yellow.....
..... **Cardiastethus** Fieber.
Predominantly brown or black species..... 6

6(5). Head much broader across eyes than length of second antennal segment .....**Poronotellus** Kirkaldy.
Head hardly as wide across eyes as length of second antennal segment 7

7(6). Hemelytra not punctate; veins of membrane obscure or obsolete .....**Lasiochilus** Reuter.
Hemelytra "minutely and closely irregularly punctate"; veins of membrane hyaline.....**Lyctocoris** Hahn.

Subfamily LYCTOCORINAE (Reuter, 1884)

This subfamily contains four of the eight genera and about three-fourths of the species found in Hawaii. The long hairs on the two apical antennal segments together with the presence of a hamus in the cell of the hind wings serve to distinguish this group from the other two.

KEY TO THE GENERA OF LYCTOCORINAE FOUND IN HAWAII

1. Sides of pronotum margined, explanate, not setose; fore femora with a tooth beneath at about distal one-fourth
.....**Lilia** White.
Sides of pronotum not or narrowly or incompletely explanate, always distinctly setose; fore femora not so armed... 2

2(1). Head about twice as long in front of eyes as length of an eye.....**Lasiochilus** Reuter.
Head, measured from above, not conspicuously longer in front of eyes than length of an eye..... 4
4(3). Metapleura with the channels of orifices strongly developed, sub-?-mark shaped, strongly curved forward to dorso-cephalic corner of each metapleuron.....**Xylocoris** Dufour.
Metapleural channels of orifices not so formed, curved caudad or otherwise different.....**Lyctocoris** Hahn.

Genus **LILIA** White, 1879:147

This genus is known only from Hawaii. Its armed fore femora and its explanate, bare, lateral pronotal margins serve to distinguish it from its congeners. "It has, in some respects, more the aspect, at first sight, of a Lygaeid than an Anthocorid due perhaps to the rows of punctures on the elytra." (White, 1879:147.)

Lilia dilecta White (fig. 71).
Lilia dilecta White, 1879:147.

Endemic. Kauai, Maui (type locality: 5,000 feet).
Hostplants: *Acacia koa* (beneath bark), *Cyanea* (in rotting stem), *Straussia.*
This is a predominantly yellowish-brown species with the pronotal disc and scutellum dark. It is one of our larger species, for it attains a length of about 3.5 mm. Kirkaldy (1904:179) says that the type has been lost.

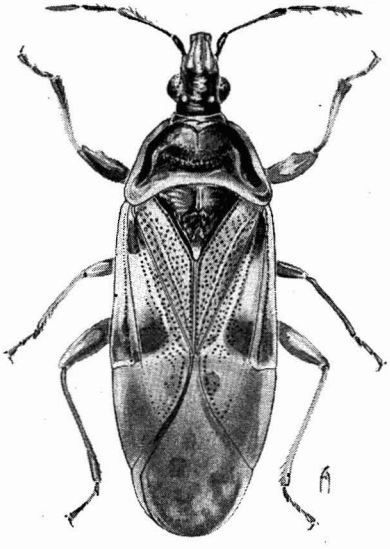

Figure 71—*Lilia dilecta* White. (Abernathy drawing.)

Genus **LASIOCHILUS** Reuter, 1871

This widespread genus has five Hawaiian species assigned to it, and it is thus the only genus of Anthocoridae which contains more than a single recorded species in Hawaii. Its species are comparatively large, up to 4 mm. in length, and are somber, dark brown or fuscous in color.

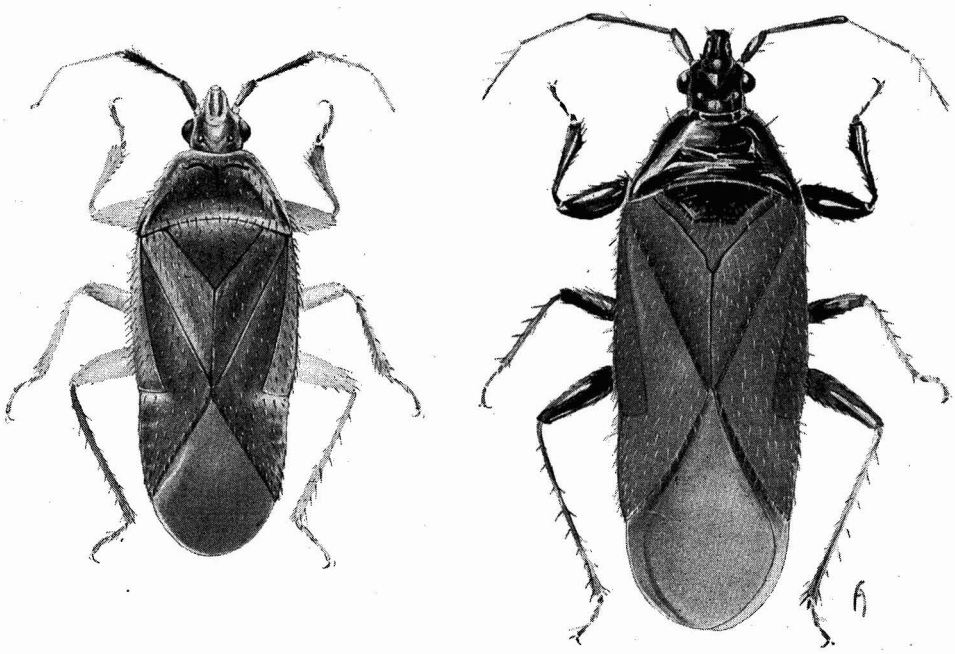

Figure 72—*Lasiochilus decolor* (White), left. *Lasiochilus denigratus* (White), right. (Drawn to same scale by Abernathy.)

Key to the Hawaiian Species of Lasiochilus

(I have not examined specimens of all of the following species, and have been unable to see authentically identified specimens of certain others. I believe that there are a number of new species to be described in this group. The key was checked by Mr. China with the British Museum material.)

1. Hemelytral membrane with "three small basal spots, and a large one apically; length 3⅛ mill."...**nubigenus** Kirkaldy.
   Membrane not maculate 2

2(1). Hemelytra distinctly maculate "clavus with a broad line near the base (by the scutellum), the clavo-corial suture, [a spot on middle of corium between embolium, claval suture and cuneal fracture], and a spot on the cuneus, yellowish-brown"; about 4 mm. long.....**montivagus** Kirkaldy.
   Hemelytra not so maculate..... 3

3(2). Scutellum with almost basal one-half shiny, remainder dull; about 3.5 mm. long.....**denigratus** (White).
Scutellum almost or entirely dull, at most shiny at extreme base.....**silvicola** Kirkaldy; **decolor** (White).

Lasiochilus decolor (White) (fig. 72).
Dilasia (?) *decolor* White, 1879:147.

Endemic. Oahu (type locality: Honolulu).
Hostplant: *Straussia.*
Kirkaldy (1904:179) says that the type has been lost. White's collection at Perth, Scotland, was examined by him. Mr. China informs me that the species is not represented in the British Museum.

Lasiochilus denigratus (White) (fig. 72).
Dilasia (?) *denigratus* White, 1879:146.

Endemic. Kauai, Oahu, Lanai, Maui, Hawaii (type locality: Mauna Kea, about 3,000 feet).
Hostplants: *Antidesma, Cibotium chamissoi, Coprosma,* dead tree-fern stem.
Kirkaldy (1904:179) says that the type has been lost.
The records applied to this species may refer to several species.

Lasiochilus montivagus Kirkaldy (fig. 73, a).
Lasiochilus montivagus Kirkaldy, 1908:197.

Endemic. Lanai (type locality: Koele Mountains), Hawaii.
Hostplant: *Cheirodendron.*
The type is in the British Museum and is figured here.

Lasiochilus nubigenus Kirkaldy (fig. 73, b).
Lasiochilus nubigenus Kirkaldy, 1908:197.

Endemic. Maui (type locality: Mount Haleakala, 5,000 feet).
Our figure is from the type in the British Museum.

Lasiochilus silvicola Kirkaldy (fig. 73, c).
Lasiochilus silvicola Kirkaldy, 1908:196.

Endemic. Kauai (type locality: Kaholuamanu).
The type is in the British Museum and is figured here.

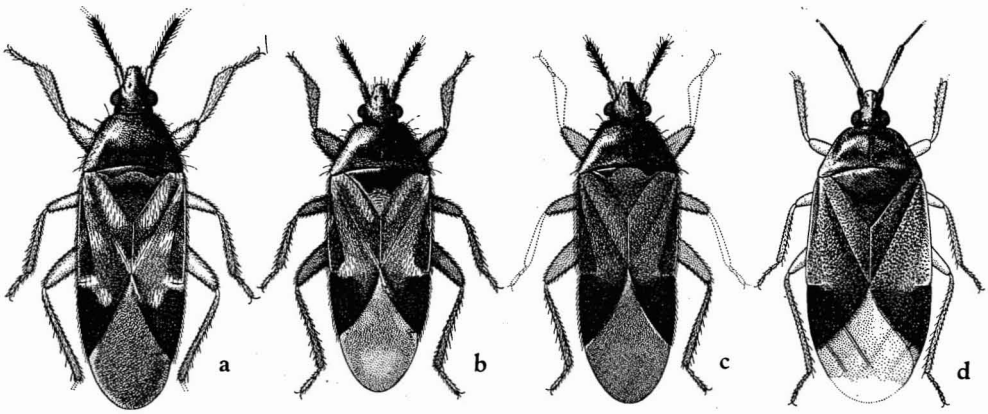

Figure 73—Holotypes of anthocorids: **a,** *Lasiochilus montivagus* Kirkaldy; **b,** *Lasiochilus nubigenus* Kirkaldy; **c,** *Lasiochilus silvicola* Kirkaldy; **d,** *Lyctocoris hawaiiensis* (Kirkaldy). (Drawn at the British Museum of Natural History by Smith.)

Genus **LYCTOCORIS** Hahn, 1836

Nesidiocheilus Kirkaldy, 1902:127. New synonym.

Genotype: *Acanthia campestris* Fabricius, fixed by Kirkaldy, 1906.

Kirkaldy described *Nesidiocheilus* as a new endemic genus and compared it with *Lilia* from which he said it differed at least by its simple fore femora and that it most closely resembled *Lasiochilus* but had punctate hemelytra. This has long been a puzzle in our fauna, but Mr. China has examined Kirkaldy's type and finds that it is the same as *Lyctocoris.*

Lyctocoris hawaiiensis (Kirkaldy), new combination (fig. 73, d).

Nesidiocheilus hawaiiensis Kirkaldy, 1902:127.

Maui (type locality: Mount Haleakala, between 7,000 and 10,000 feet).

Immigrant (?). Mr. China tells me that the unique holotype (figured here) in the British Museum is "closely allied to *Lyctocoris campestris* F. and probably merely a form of this cosmopolitan species." It has never been collected since it was described, to my knowledge, and I feel that perhaps it should be removed from our list.

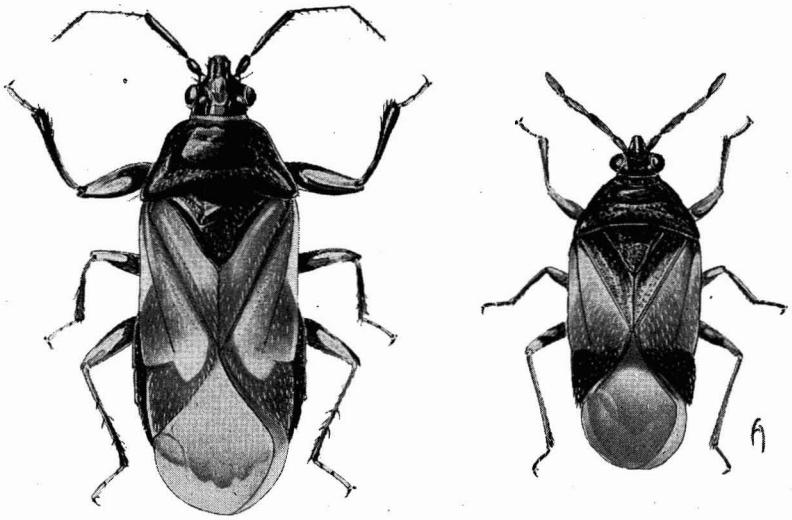

Figure 74—*Xylocoris discalis* (Van Duzee), left. *Orius persequens* (White), right. (Drawn to same scale by Abernathy.)

Genus **XYLOCORIS** Dufour, 1831

Genotype: *Xylocoris rufipennis* Dufour, the only species included by Dufour.

This widespread genus is represented in our fauna by one immigrant species. The long, strongly developed, anteriorly curved metapleural orifice together with the bicolored hemelytra will serve to distinguish this genus from its associates here.

Xylocoris discalis (Van Duzee) (fig. 74).
Scoloposcelis discalis Van Duzee, 1914:15.

Oahu.

Immigrant. A western North American species. It was first collected in the Territory at Honolulu in 1921 by S. Bickerton.

The membrane and most of the remainder of the hemelytra, excepting most of the area behind the fracture, is white or subhyaline.

Subfamily ANTHOCORINAE (Reuter, 1884)

The antennae are comparatively stouter with obviously shorter setae in this subfamily than in the Lyctocorinae. A single species occurs in Hawaii.

Genus **ORIUS** Wolff, 1811

Triphleps Fieber, 1860.
Genotype: *Salda nigra* Wolff, the only species included by Wolff.

Orius is a widespread genus of minute anthocorids. A number of beneficial, predaceous species belong here. The eggs of the corn ear worm (*Heliothis*) are preyed upon by a species of this genus in Australia and North America.

Orius persequens (White) (fig. 74).
Triphleps persequens White, 1877:111.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii, Nihoa, Midway, Kure, Wake.

Immigrant. Widespread in the Pacific. Described from the Territory (but no more specific type locality designated by White).

Kirkaldy (1910:121) recorded *T. pumilio* Champion from Oahu, but he apparently was in error.

According to Kirkaldy (1904:179), the type of *persequens* has been lost.

Hosts: common and widespread on many kinds of plants where it feeds upon aphids, hemipterous and homopterous nymphs and thrips. It has been observed feeding on small nymphs of Orsillini. At times it helps considerably in the control of various thrips. It is often abundant in flowers. I have seen numbers of dead specimens caught on the sticky surfaces of tobacco leaves infested with aleyrodids.

The eggs are inserted in plant tissue, and have been found in *Portulaca.* The nymphs are yellowish, and the nymphal period was reported by Swezey (1905:235) to be 14 days.

Subfamily DUFOURIELLINAE Van Duzee, 1916

The character used to separate this subfamily from the Lyctocorinae and Anthocorinae is a difficult one to see, for one hemelytron must be lifted or removed to examine the hind wing to note whether or not the cell lacks a hamus (a short spur vein projecting into the cell). However, two of the three immigrant species we have in Hawaii are distinguishable at a glance once they are known. Their antennae have long hairs and can only be confused with the Lyctocorinae. These two species are mostly pale yellowish or brownish-yellow and thus can only be confused, perhaps, with *Lilia dilecta,* but that species has the pronotum and scutellum largely dark and is nearly bare above, whereas these species have the pronotum and hemelytra conspicuously hirsute. The third species included herein, *Poronotellus sodalis,* cannot be so easily distinguished. It does, however, have the

hind margin of the pronotum deeply, concavely emarginate and the discs of the pronotum and of the scutellum have a distinct and comparatively deep transverse impression as do those of *Physopleurella* and *Cardiastethus.*

KEY TO THE GENERA OF DUFOURIELLINAE FOUND IN HAWAII

1. Rostrum hardly as long as head, not reaching fore coxae; fore tibiae distinctly arcuate.....**Physopleurella** Reuter.
   Rostrum longer than head, reaching or passing fore coxae; fore tibiae straight 2
2. Our species pale yellow; head only about as broad across eyes as length of second antennal segment.....**Cardiastethus** Fieber.
   Our species dark colored; head much broader across eyes than length of first antennal segment.....**Poronotellus** Kirkaldy.

Genus **PHYSOPLEURELLA** Reuter, 1885

Although our single immigrant species of this genus resembles *Cardiastethus,* it readily may be distinguished generically by its short rostrum, its slightly arcuate fore tibiae and by its stouter femora which are multi-spinulose beneath.

Physopleurella mundula (White) (fig. 75).
Cardiastethus mundulus White, 1877:111.

Kauai, Oahu, Molokai, Maui, Hawaii. (No specific type locality designated by White.)

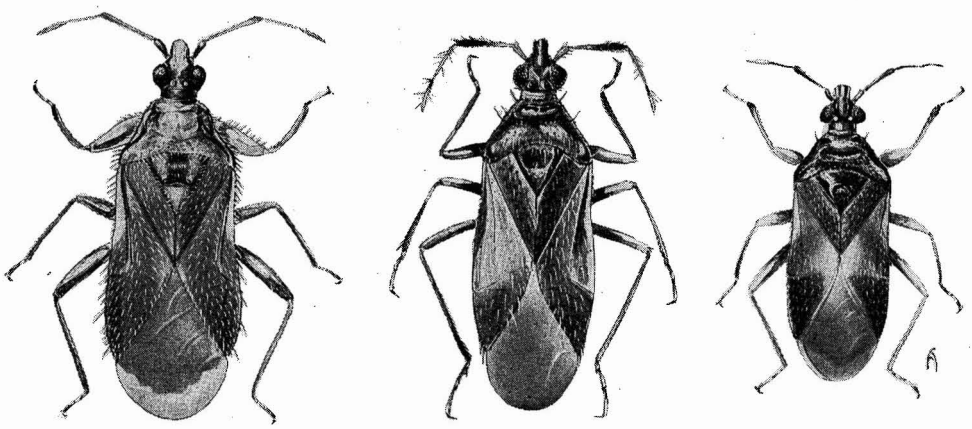

Figure 75—*Physopleurella mundula* (White), left. *Cardiastethus fulvescens* (Walker), middle. *Poronotellus sodalis* (White), right. (Abernathy drawings.)

Immigrant. Probably widespread in the Pacific. Usinger (1946:55) records it from Guam.

Swezey (1905:235–236, pl. 16, figs. 4–6) reported finding it feeding on aphids, psocids and young sugarcane leafhoppers. "The eggs are .6 mm. long, yellowish, with a raised collar or crown at anterior end, laid flat on a leaf, singly, in [a] secluded place. Some were found under the web or nest of Psocids on orange leaves. A few laid in confinement hatched in 4 to 5 days. The nymphs are reddish in color and of very lively habits, though keeping secluded generally."

White (1878:365) records Blackburn's field note as follows: "Not rare about the outside of roofs of houses." Perkins (1913:cc) found it ". . . especially common, sometimes occurring in countless numbers as in the cane-fields at Paauhau in 1903, hiding amongst the dead cane-leaves, where it preyed largely on Psocidae and small leaf-hoppers. On the leaves of growing trees or shrubs, such as crotons, oranges, mulberries, etc., the conspicuous red nymphs and mature bugs are often found beneath the webs made by the Psocidae, which feed on the black fungous growth that springs up on the excretions of various scale insects infesting these trees. One may find at such times a small flock of Psocids resting side by side with their enemy, beneath the covering made by the former."

I have found dead specimens caught on the sticky surfaces of tobacco leaves.

Genus **CARDIASTETHUS** Fieber, 1860

Genotype: *Cardiastethus luridellus* Fieber, fixed by Kirkaldy, 1906.

The rostrum extends onto the mesosternum, the fore femora are slender, hirsute but not spinulose beneath, and the fore tibiae are nearly straight throughout. Each of these characters differs from those of *Physopleurella*. The genus is widespread.

Cardiastethus fulvescens (Walker) (fig. 75).

Xylocoris fulvescens Walker, 1872:160.

Xylocoris fumipennis Walker, 1872:160. Synonymy by Distant, 1904:221.

Amphiareus fulvescens (Walker) Distant, 1904:220; 1906:4, fig. 3. Genotype of *Amphiareus*.

Kauai, Oahu.

Immigrant. Described from Ceylon; widespread in the Indo-Pacific area. First recorded from Hawaii by Usinger (1946:55) from specimens taken in Honolulu as early as 1910.

Genus **PORONOTELLUS** Kirkaldy, 1904:280

Poronotus Reuter, 1871.
Buchananiella Reuter, 1885.

This genus is also represented in Hawaii by a single immigrant species. Our species is somewhat similar in color pattern to that of our *Xylocoris,* but the two genera can be separated by a glance at the metapleura. On this genus the metapleural orifice curves backward to the middle of the hind margin of the metapleuron whereas it curves sinuously to the fore margin in *Xylocoris.*

Poronotellus sodalis (White) (fig. 75).
Cardiastethus sodalis White, 1878:372.
Buchananiella sodalis (White), of authors.

Kauai, Oahu, Maui. (Type locality not given by White, but probably Oahu.)

Immigrant. Known also from Guam; probably a widespread species.

Hostplants: *Acacia farnesiana, Acacia koa,* corn, sabal palmetto, sorghum, sugarcane, under dead *Eucalyptus* bark, among fungi on *Acacia koa.* I have found many dead specimens caught on the surface of tobacco leaves infested with "white fly."

Family **CRYPTOSTEMMATIDAE**

Dipsocoridae Dohrn, 1859.
Ceratocombidae (Reuter) Fieber, 1860.

Jumping Ground Bugs

This is a small family of peculiar bugs. A recently discovered, immigrant species is the only representative known to occur in Hawaii; it resembles somewhat certain anthocorids.

Small species less than 2 mm. long; ocelli situated close to eyes; antennae four-segmented, basal two segments stout, apical two slender, conspicuously hairy; rostrum long, three-segmented; hemelytra semimembranous, and of nearly similar texture throughout; tarsi three-segmented.

Genus **CERATOCOMBUS** Signoret, 1852

Genotype: *Anthocoris cleopatrata* Zetterstedt, the only species included by Signoret.

Subgenus **Xylonannus** Reuter, 1894

Ceratocombus hawaiiensis Usinger (fig. 76).

Ceratocombus (*Xylonannus*) *hawaiiensis* Usinger, 1946:633.

Kauai.

Immigrant. Source undetermined, but closely similar to the American *vagans* McAtee and Malloch. First found by Krauss beneath the bark of a dead tree at Waipahee, Kauai (type locality), in January, 1944.

This tiny, smoky-winged, peculiar bug is easily distinguishable from all other bugs in Hawaii. The hemelytra do not overlap behind, but are divergent caudad.

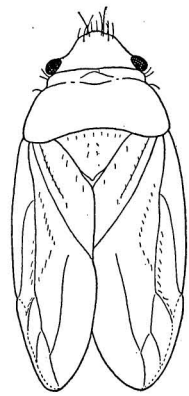

Figure 76—*Ceratocombus hawaiiensis* Usinger. (Outline sketch of holotype by J. T. Yamamoto.)

Family **MIRIDAE** (Hahn, 1831)

Mirides Hahn, 1831.
Capsinae Burmeister, 1835.
Capsidae Kirby, 1837.

Leaf Bugs

This is the largest family of Heteroptera. It is generically the most diversified of the Hawaiian bugs, and is only exceeded in numbers of known species by the Lygaeidae. However, the group has not been studied adequately, and there are many undescribed species as well as some new genera in our collections. It is the largest family of Hawaiian bugs, I believe, and it is probable that detailed study will reveal that only a modest fraction of the existing species has been described.

The family may be distinguished by the following diagnosis: ocelli absent; antennae four-segmented; rostrum four-segmented, the first segment as long as or longer than the head; hemelytra (when not brachypterous as in some species) with clavus, corium, fracture, cuneus (fracture and cuneus absent in *Sulamita*) and membrane usually well developed, membrane with one or two closed cells (areoles), one larger than the other; tarsi three-segmented, claws with arolia in most genera and sometimes with pseudarolia.

Most of the species are small, delicate, soft bodied and need special care when being collected and mounted. Many of our species are beautiful insects and have striking colors, including greens and reds, arranged in pleasing patterns and shades. Most species are fast-moving insects, and some are difficult to capture.

There is a large number of species over the world which are of minor or major importance as pests of economic plants. We have several of these noxious species here, but we also have some species which have predaceous habits and are definitely beneficial and aid materially in the control of certain important crop pests.

It is known that many species of Miridae drill holes with their beaks and then force their ovipositors into the prepared holes to lay their eggs. One or two eggs to a puncture is the usual number. They may be inserted in soft growing tissue, in old woody tissues, in scars or in dead wood.

Blackburn (1888:348) said of this family:

> The *Capsina* are, comparatively speaking, rather plentiful in the Hawaiian Islands. I possess upwards of forty species, of which I have not been able to send much more than a dozen to Dr. White. Unfortunately these are among the frailest of insects, and a great many of my species are represented by single types, some of them in inferior condition. From collecting expeditions I was usually obliged to bring home most of my captures unmounted, in sawdust, and the *Capsina* often suffered. The obscurity and difficulty of this group are so great that I think an entomologist who has not made them a special object of study would be more likely to hinder than assist future workers if he attempted to deal with them in print, and I act on this opinion by passing on without further remark....

Knight (1941:2) says,

> Many mirid species have been observed to possess during nymphal development the curious habit or ability of protruding a posterior portion of the rectum; when a nymph is dislodged and falls from a branch or leaf to the foliage below, the rectum is protruded, and, being provided with sticky material, acts as an adhesion disk upon striking the foliage of the limbs below. The nymph then scrambles for a foothold, pulls the adhesion disk free, retracts the rectum and runs for cover among the leaves. Thus the eversible rectal disk saves many falling nymphs from losing contact with the host plant.

It will be noted from the following text that considerable changes have been made in the arrangement of the Hawaiian members of the family. Study revealed that several of the genera had been assigned to subfamilies with which they had little in common. In spite of these changes, I realize that the group remains in great need of detailed study and thorough revision. We have accomplished little more than a preliminary survey of these interesting Hawaiian creatures.

KEY TO THE SUBFAMILIES OF MIRIDAE FOUND IN HAWAII

1. Head, viewed from above, porrect, cone-shaped, eyes appearing to be slightly overlapped by prothorax; tylus strongly and peculiarly produced, laterally compressed, about as long, measured from side, as length of eye; head as in figure 95 (*Oronomiris*).....part of **Mirinae.**
Head not so formed, even if porrect..... 2

2(1). Fracture and cuneus absent, but hind femora never greatly enlarged for leaping (*Sulamita*).....part of **Bryocorinae.**
Fracture and cuneus present, or hind femora greatly enlarged for leaping 3

3(2). Areoles of hemelytra each entire, not divided into a large and small cell by a vein (fig. 80)..... 4
Areoles of hemelytra each divided into two cells by a vein (fig. 91) (look carefully; sometimes the small cell is difficult to see) or hind femora enlarged for leaping..... 7

4(3). Pronotum strongly inflated and conspicuously gibbose posteriorly (fig. 80) (*Pycnoderes*).....part of **Bryocorinae.**
Pronotum not strongly gibbose posteriorly..... 5

5(4). Tibiae with fine hair only and without numerous long slender spines .....**Cylapinae.**
Tibiae with numerous, conspicuous, long, erect, slender spines in addition to shorter hairs..... 6

6(5). Pronotum with a conspicuous collar.....**Dicyphinae.**
Pronotum without a collar.....part of **Phylinae.**

7(3). Hemelytra without membrane, jumping species (*Halticus* and *Nesidiorchestes*).....part of **Heterotominae.**
Hemelytra with membrane developed..... 8

8(7). Pronotum with a distinct collar; tarsal arolia distinctly strongly divergent .....**Capsinae.**
Without such a combination of characters..... 9

9(8). Arolia of tarsal claws conspicuous, finger- or flap-like, not bristle-like, curved or sinuate, distinctly convergent; tarsal claws normally widely divaricate.....10
Arolia of tarsal claws absent or indistinct, if present, straight, erect and bristle-like but not fleshy or finger- or flap-like; tarsal claws normally divergent rather than divaricate in most of our species.....12

10(9). Tibiae hirsute or finely setose but not bearing spines (*Kalania*).....part of **Bryocorinae.**
Tibiae with numerous, long, conspicuous, well-developed spines 11

11(10). Pronotum with well-developed collar (*Nesiomiris*).....
.....part of **Mirinae.**
Pronotum without a collar.....**Heterotominae.**

12(9). Eyes distinctly separated from thorax, head constricted and shortly neck-like behind them (see fig. 88 of *Cyrtorhinus*).....part of **Heterotominae.**
Eyes contiguous or subcontiguous to prothorax, obviously unlike *Cyrtorhinus,* but as in figures 77, 78.....**Phylinae.**

Subfamily PHYLINAE Reuter, 1910

In this group the hemelytral membrane has the cell divided into two areoles, the pronotum lacks a conspicuous collar, the tarsal arolia are either absent or bristle-like, the eyes are placed near the pronotum and the tylus is not compressed or protuberant as in the Mirinae.

Key to the Genera of Phylinae Found in Hawaii

1. Second antennal segment little longer than third, never conspicuously longer, but it may be heavier.... **Leucopoecila** Reuter.
   Second antennal segment much longer than third, longer than remainder of antenna in some forms..... 2
2. Hemelytra with fine prostrate or reclinate hair only, without erect bristles; pale yellowish species; tibial spines not arising from dark spots..... **Campylomma** Reuter.
   Hemelytra with two distinct types of setae, one fine, prostrate or reclinate, the other erect, or suberect, stouter, darker colored, conspicuous bristles; tibial spines arising from dark spots..... **Psallus** Fieber.

Genus **LEUCOPOECILA** Reuter, 1907:26

Leucopoecila albofasciata Reuter (fig. 77).
Leucopoecila albofasciata Reuter, 1907:26. Genotype.

The garden fleahopper.

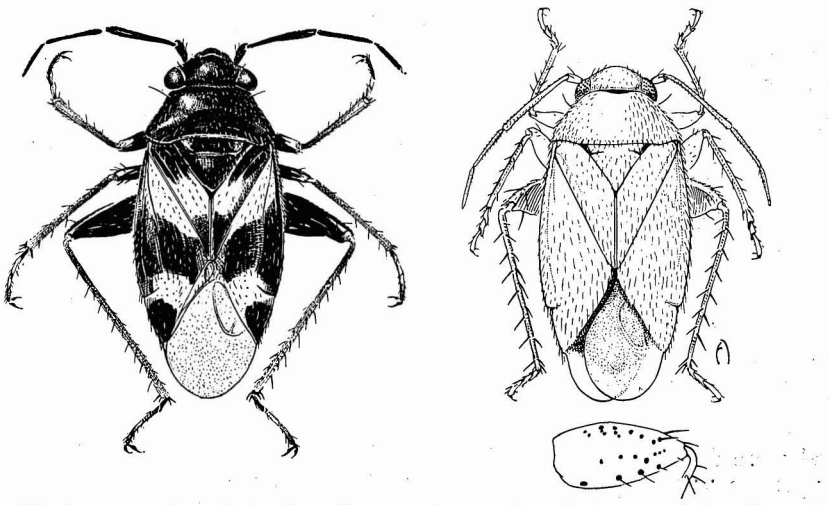

Figure 77—*Leucopoecila albofasciata* Reuter, the garden fleahopper, left. *Campylomma hawaiiensis* (Kirkaldy), right, with a sketch of a hind femur to show the characteristic dark spots. (Abernathy drawings.)

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Widespread in North America. First found in the Territory by Terry in 1909 on Kauai.

Hostplants: beets, Bermuda grass, carrot, Chinese cabbage, corn, pigeon pea, *Portulaca,* nightshade, Swiss chard.

This is a nervous-acting, fast-moving bug that is difficult to capture—especially on a hot, bright day. It takes wing at slight disturbances. Sometimes it becomes abundant in gardens and is common in the field. The eggs are inserted in the leaves and stems of its hostplant. It occasionally comes to lights.

Both brachypterous and macropterous forms occur. The second antennal segment is enlarged in the male (conspicuously more swollen than in the female), and its lower surface is concave to form a large, conspicuous, sensory canal which extends almost the entire length of the segment.

It has been reported damaging seedlings of beets, carrots, chard, cabbage and pigeon pea in Hawaii by causing the cotyledons to shrivel with subsequent death of the young plants. The grass of golf course greens in some places in the United States has been damaged.

No satisfactory control measures have been worked out for it in Hawaii.

Genus **CAMPYLOMMA** Reuter, 1884

Genotype: *Campylomma nigronasuta* Reuter, fixed by Distant.
Opuna Kirkaldy, 1902:140, new synonym.

Campylomma reaches its greatest development in the Indo-Pacific regions. It is well developed in the islands from Fiji to the Marquesas (eleven species have been described from the Marquesas alone). The genus can be distinguished from our other Phylinae as follows: its second antennal segment is subequal in length to the third and fourth combined, thus separating it from *Leucopoecila;* from *Psallus* it differs by not having erect setae on the hemelytra (both genera have hair) and by lacking the dark spots at the bases of the spines on the tibiae. The dark spots at the bases of the femoral spines are not so well defined on our species as on some of those found elsewhere.

The single species established here has caused considerable confusion to local workers ever since it was so poorly and inaccurately described by Kirkaldy. He described *Opuna* as having a "wide collar" on the pronotum and stated that he had "placed this provisionally in *Halticaria,* notwithstanding its well-marked collar. It has the general appearance of an *Orthotylus.*" (1902:140.) His figure shows no such collar, and it has been suggested that the insect described and the one figured were different species. Mr. China has kindly examined Kirkaldy's unique type in the British Museum for me and has sent the following note: "*Opuna* Kirk. is undoubtedly synonymous with *Campylomma* Reuter. The collar mentioned by Kirkaldy is an optical illusion caused by the teneral state of the specimen whereby

the anterior third of the pronotum is transluscent so that the internal structure of the prothorax and occipital foramen of the head shows through, giving the appearance of a definite transverse suture. The upper surface of the pronotum is actually devoid of any transverse suture." Certainly one could not identify Kirkaldy's genotype from his description, but the confusion is at long last cleared up.

Campylomma hawaiiensis (Kirkaldy), new combination (fig. 77).
Opuna hawaiiensis Kirkaldy, 1902:140, pl. 5, fig. 29.
Campylomma hawaiiensis Usinger, 1943:287, fig. 1. New synonym.

Oahu (type locality: "S.E. Coast").
Immigrant. Known also from Wake Island and probably more widely spread.
Hostplant: *Sida.*
This species is easily recognized among our related Heteroptera, for it is unusually pale yellowish. It is a lowland species which has been found only in the Honolulu area.

Genus **PSALLUS** Fieber, 1858

Genotype: *Cimex roseus* Fabricius, fixed by Distant, 1904.

A widespread, nearly cosmopolitan genus with four described species in Hawaii, but there are undescribed species in our collections. A careful study of the Hawaiian members of the group will probably reveal a rather large complex of species here. As it now stands, the group is poorly known in these islands. The long second antennal segment (which is longer than the remainder of the antenna in some species) in combination with the spotted tibiae and two types of vestiture on the hemelytra will serve to separate our species from the members of *Leucopoecila* and *Campylomma* occurring here. The species closely resemble our *Orthotylus.*

In 1917 Van Duzee used *Apocremnus* Fieber, 1858, for this group because the name has page priority. However, he was not the first reviser, and *Psallus* stands.

On the mainland, especially in the southern states, a member of this genus is a serious pest. It is *Psallus seriatus* (Reuter), the cotton fleahopper, which attacks small cotton buds causing them to drop.

The Hawaiian forms are poorly known, and some confusion exists as to their proper names. A careful revision will be required to clarify the situation. An inquiry sent to Mr. China brought the following reply:

We have in our collection only one Hawaiian species of *Psallus,* that is *P. sharpianus* Kirk. We have a card on which two specimens had been mounted and one of which has been lost. The specimen (male) is labelled:—"Halemanu, Kauai 4,000 ft. Perkins V. 1895. *Psallus sharpianus* Kirk. Type. Specimen figured?" In running it down in your key I would scarcely call it mostly reddish. It would go better into the alternative since it is a pale testaceous. The hemelytra are scattered with distinct small fuscous spots. The hind femora of the lost

specimen, which remain on the card are pale with fuscous spots but those of the sole remaining specimen are pale with the spots very much less distinct. There is one more specimen (female) under this specific label and this is labelled "Kona, Hawaii 4,000 ft. 8. 1892 Perkins. Sharpi male, female, specimen figured." This specimen is minus antennae, legs and hemelytra and wings so that it is difficult to say what it really is. There is no variety *a* at all.

This poses several questions. Kirkaldy definitely states that typical *sharpianus* is a reddish species, and his colored figure leaves no doubt of this. Only one form was illustrated, but Mr. China points out that two examples are labeled as having been figured. Kirkaldy, in some supplementary notes (1908:197) published without access to his types, stated that the type of *sharpianus* was a "Kauaian specimen." As noted elsewhere, Kirkaldy made many confusing statements, and I believe this is another. It appears that the type of typical *sharpianus,* and the specimen figured, is the Kona, Hawaii, example which is now in fragments, and that the pale, testaceous form from Kauai (I have collected specimens on Kauai that agree with the description of this form) is what Kirkaldy called variety "*a.*" Perhaps he labeled the pale form "specimen figured," and planned to figure it but such a figure was not published. The type of *pelidnopterus* should be in the British Museum with *sharpianus;* perhaps it has been lost or destroyed.

There may be some material in the Bishop Museum's and Perkins' shares of the *Fauna Hawaiiensis* material which would reveal certain details of value in interpreting the species of this group, but, unfortunately, that material was not available for study because of the war. It is on loan to Dr. Usinger.

Key to the Hawaiian Psallus

1. Species mostly reddish in color 2
   Fuscous or testaceous species 3
2(1). Hemelytra unspotted ..... **kirkaldyi** (Perkins).
   Hemelytra with scattered but distinct small fuscous spots ..... **sharpianus** Kirkaldy.
3(1). Hind femora broadly infuscated ..... **swezeyi** Kirkaldy.
   Hind femora pale or pale with fuscous spots 4
4(3). "Blackish-brown, cuneus (more or less), femora (more or less), apical half of head, lateral margins (widely) of pronotum, and two spots at base of pronotum—yellowish" (original description) ..... **pelidnopterus** (Kirkaldy).
   Pale testaceous, hemelytra with scattered, small dark spots ..... **sharpianus luteus** Zimmerman.

Psallus kirkaldyi (Perkins), new combination.
Tichorhinus kirkaldyi Perkins, 1912:731.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Styphelia* (*Cyathodes*).
This species has the characters of *Psallus,* not of *Orthotylus* (*Tichorhinus*), and must be transferred. The types are in the Bishop Museum.

Psallus pelidnopterus (Kirkaldy).

Psallus sharpianus variety *pelidnopterus* Kirkaldy, 1902:132.

Psallus pelidnopterus (Kirkaldy) Kirkaldy, 1909:197.

Endemic. Hawaii (type locality: Hualalai, 5,000 feet).

Hostplant: *Acacia koa.*

I do not know where the type is. I have been unable to find it in Hawaii, and the species is not represented at the British Museum.

Psallus sharpianus Kirkaldy (fig. 78).

Psallus sharpianus Kirkaldy, 1902:131, pl. 5, fig. 31; 1908:197.

Endemic. Kauai, Maui, Hawaii (type locality: Kona, 4,000 feet).

Hostplants: *Acacia koa, Euphorbia.*

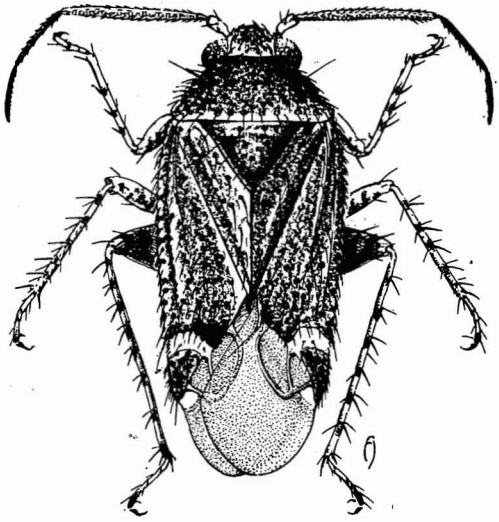

Figure 78—*Psallus sharpianus* Kirkaldy. (Abernathy drawing.)

Psallus sharpianus variety **luteus,** new name.

Psallus sharpianus variety *a* Kirkaldy, 1902:132.

Endemic. Kauai (type locality: Halemanu, 4,000 feet), Oahu, Maui, Hawaii.

Hostplant: *Acacia koa.*

Kirkaldy said that this form differs from typical *sharpianus* because it has the sanguineous coloring replaced by luteous. It may be a distinct species.

Psallus swezeyi Kirkaldy.
Psallus swezeyi Kirkaldy, 1910:120.

Endemic. Oahu (type locality: Waianae Mountains, 2,000 feet).
Hostplant: *Pipturus.*
The holotype is in the Hawaiian Sugar Planters' Association Experiment Station, Honolulu.

Subfamily DICYPHINAE Oshanin, 1912

Our members of the Dicyphinae may be distinguished from our other subfamilies of bugs by the following combination of characters: body elongate, slender; pronotum with a conspicuous collar; cell of hemelytral membrane not divided into two areoles, and tibiae with well-developed spines. A single genus represents the group in Hawaii.

Genus **ENGYTATUS** Reuter, 1875

Our species have been included in the genus *Cyrtopeltis,* but Dr. Usinger says that *Engytatus* should be used for them (see his detailed discussion, 1946:73–75). One immigrant plant pest and two native species have been recorded from Hawaii, but there are a number of new species awaiting description in local collections. The genus is a large one in our fauna, I believe. The asymmetrical male genitalia display fine specific characters which undoubtedly will be used extensively when future workers revise the group.

Key to the Hawaiian Species of Engytatus

1. Second antennal segment more than twice as long as breadth of head across eyes.....**confusus** (Perkins).

   Second antennal segment less than twice as long as breadth of head across eyes 2

2. Narrowest interocular distance about three-fourths as great as length of median line of pronotum from base to collar; second antennal segment but little longer than breadth of head across eyes; dorsum yellow, not infuscate or maculate; setae of corium spine-like, dark colored as compared with corium; antennae predominantly yellow.....**hawaiiensis** (Kirkaldy).

   Narrowest interocular distance about one-half as long as median line of pronotum from base to collar; second antennal segment one-third longer than breadth of head across eyes; dorsum infuscate and maculate; setae of corium fine, hair-like, pale; antennae predominantly dark.....**geniculatus** Reuter.

Engytatus confusus (Perkins) (fig. 79).

Cyrtopeltis confusa Perkins, 1912 (1911):729, fig. *a.*

Engytatus confusus (Perkins) Usinger, 1946:75.

Endemic. Oahu (type locality not further delimited by Perkins, but probably from the Mount Tantalus region).

Hostplants: *Cyrtandra, Gouldia* (common on this host), *Straussia, Touchardia.*

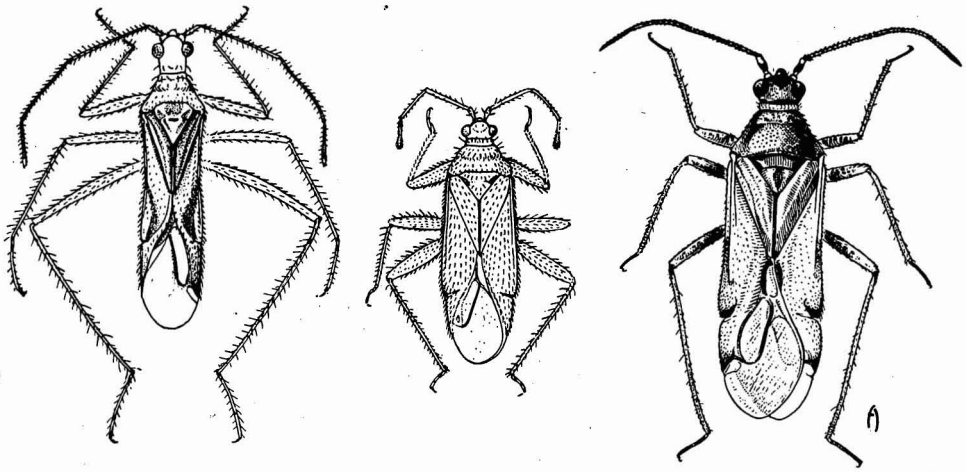

Figure 79—*Engytatus confusus* (Perkins), left. *E. hawaiiensis* (Kirkaldy), middle. *E. geniculatus* Reuter, right. (Drawings by Abernathy; not to same scale.)

Perkins (1912:730) wrote concerning this species and *hawaiiensis*:

This is the species referred to by Kirkaldy in his supplement to the Hemiptera, "Fauna Haw.," II, p. 553, as *Cyrtopeltis hawaiiensis,* but it clearly has nothing to do with that species, described in the same work, p. 138. The original series of *C. hawaiiensis,* excepting the type set, was destroyed during one of Mr. Kirkaldy's illnesses in hospital for want of attention. There was therefore no reason to assume, without comparison of specimens, that his original description of *Cyrtopeltis* was erroneous. I have an example from near the Waianae coast of Oahu, which agrees exactly with Kirkaldy's description of *C. hawaiiensis,* but is rather smaller. I should think *C. confusa* is decidedly not even congeneric with *C. hawaiiensis,* the very different antennae and pronotum, the larger and more coarsely faceted eyes and many other distinctions separating the two. At present, however, it is only necessary to call attention to the existing confusion of species with entirely different habits and appearance, especially as *C. confusa* is one of the most familiar endemic Hemiptera of the Honolulu district. *C. hawaiiensis* will probably be found on *Dodonaea viscosa,* which grows freely both above and below the true forest belt.

Engytatus geniculatus Reuter (fig. 79).

Engytatus geniculatus Reuter, 1876:83. Genotype.

Cyrtopeltis geniculatus (Reuter), not of Fieber.

Cyrtopeltis varians (Distant), as a misidentification.

The tomato bug.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant from the United States. First found in the Territory by Swezey in Manoa Valley, Honolulu, in 1924.

Hostplants: *Gynandropsis pentaphylla, Lagenaria* (gourd), *Plumbago,* tobacco, tomato, squash.

This species has in recent years become a pest of importance in Hawaii where it causes severe losses to the tomato crop. The bugs feed on the stems of the flower buds, ringing them with punctures and causing the buds to drop off before opening, thus reducing set of fruit. The exact nature of the cause of the so-called "blossom drop" has not been satisfactorily explained. Some workers have thought that egg laying caused the blossoms to drop, others believe that there is a physiological upset resulting from the feeding punctures, and some workers have considered soil deficiencies and other factors to be involved and that the bug was not a serious factor in blossom drop. It appears, however, that this bug is really a culprit and does cause blossom drop. Illingworth thought that it might be involved in the transmission of a mosaic disease, but no conclusive data have been presented.

These insects have predaceous as well as herbivorous habits, for they are known to feed upon mealybugs, aphids, eggs and young lepidopterous larvae (including those of the cabbage butterfly), and other small insects. They occasionally are attracted to lights and are active at night.

The nymphs pass through five stages in about nine or ten days. The first stage nymphs are yellowish with very conspicuous red eyes. Second stage, lighter color, more greenish and active, eyes brown. Third stage, greener body, yellowish head, nodes and distal segment antennae blackish. Fourth stage, more green, wing pads beginning to show, eyes blackish. Fifth stage, very green, eyes darker, wing buds reaching one-third the length of the abdomen. (Illingworth, 1937:457–458.)

Control: Illingworth reported good control by using a fine fog spray of one quart Pyrethrum 20 to five gallons of deo-base oil.

Engytatus hawaiiensis (Kirkaldy) (fig. 79).

Cyrtopeltis hawaiiensis Kirkaldy, 1902:138.

Engytatus hawaiiensis (Kirkaldy) Usinger, 1946:75.

Endemic. Oahu, Maui (type locality: Haleakala Crater).

Hostplants: *Raillardia* sp., *Raillardia menziesii.*

Kirkaldy (1910:553) altered his original description, but was in error by doing so. He confused another species with *hawaiiensis.* See Perkins' explanation and discussion under *E. confusus* above.

Subfamily BRYOCORINAE Douglas and Scott, 1865

The three genera representing this subfamily in Hawaii are easily distinguished as follows: eyes contiguous to thorax, second antennal segment longer than the following two segments together, pronotum usually conspicuously convex and inflated or gibbose; *Pycnoderes* and *Sulamita* have each hemelytral areole entire, not divided by a vein into two cells, but it is divided in *Kalania;* fracture and cuneus absent in the peculiar endemic *Sulamita;* tibiae not spinose.

Key to the Tribes of Bryocorinae Found in Hawaii

1. Fracture and cuneus absent..... **Sulamitini.**
   Fracture and cuneus present..... 2
2. Hemelytral areoles entire..... **Pycnoderini.**
   Areoles each divided into two cells by a distinct vein..... **Kalaniini.**

Tribe PYCNODERINI (Reuter, 1910)

Genus **PYCNODERES** Guérin-Méneville, 1857

We have one Neotropical immigrant garden pest to represent this genus in Hawaii. It is a conspicuous, distinct and easily recognized species.

Pycnoderes quadrimaculatus Guérin-Méneville (fig. 80).

Pycnoderes quadrimaculatus Guérin-Méneville, 1856:169.

The bean mirid (bean capsid).

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant from the United States mainland; originally a Neotropical species. First found in the Territory by Illingworth in 1929 on Oahu.

Hostplants: *Cucumis dipsaceus,* cucumber, dishcloth gourd, garden bean, lima bean, okra, pole bean, *Portulaca,* pumpkin, spiny cucumber, squash, sweet potato, white mustard cabbage.

Parasite: *Anagrus yawi* Fullaway (Hymenoptera: Mymaridae), introduced from Mexico in 1943.

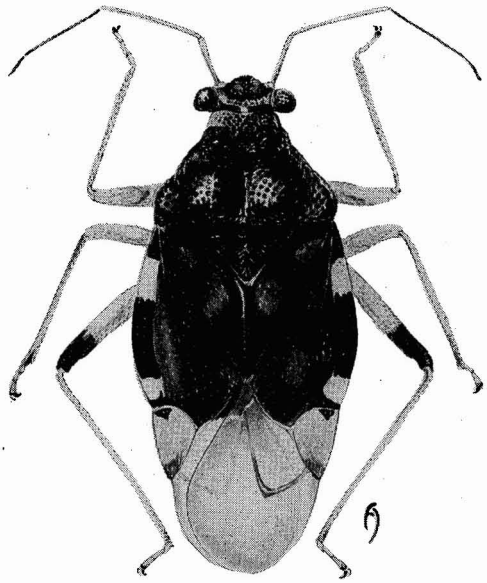

Figure 80—*Pycnoderes quadrimaculatus* Guérin-Méneville, the bean mirid. (Abernathy drawing.)

This species, whose salient and distinctive features are clearly demonstrated by our illustration, has become a pest of considerable importance to the growers of green beans in Hawaii, especially in the drier areas. At times, the bugs become excessively abundant on bean foliage, which becomes heavily spotted with black excrement beneath; the upper surface becomes pale speckled. The bug is attracted to lights.

On the mainland, this species is variously known as the squash capsid, the cucumber, melon or cassaba bug and is reported by Essig (1929:363) as "a pest to cucurbs and is particularly injurious to cucumbers, cassaba, cantaloupes, muskmelon, squash and watermelon, but also feeds on beans, lettuce, other garden vegetables, and weeds."

Control: various dusts and sprays give good control. The Hawaii Agricultural Experiment Station found that a 3 percent nicotine–lime dust and a "1:600 nicotine sulfate plus 1 pt. per 100 gal. fish-oil soap" gave satisfactory control.

A fungus (*Entomophthora sphaerosperma* Fresenius) attacks the bugs and they are preyed upon by *Zelus renardii,* a reduviid.

Tribe SULAMITINI, new tribe

Division *Sulamitaria* Kirkaldy, 1902:129.

This is an endemic group chiefly characterized by the peculiar absence of the usual mirid fracture and cuneus of the hemelytra. Kirkaldy's original diagnosis

(1902) reads "No trace of a cuneal suture in either form. Anterior part of scutellum covered, no pronotal collar. Pronotum and elytra impresso-punctate, membrane with two cells (one obsolete), clavus distinct, corium with a central nervure; wings with an areole, no hamus. Posterior coxae almost contiguous, remote from lateral margin of body; posterior femora subelongate, not incrassate."

In answer to my inquiries, W. E. China has kindly sent me the following information from the British Museum:

Sulamita is undoubtedly a member of the Bryocorinae and I think you are right in considering it as representing a distinct tribe, Sulamitini, based largely on the absence of a cuneus. This genus is obviously derived from the Prodromini (*Prodromus* Dist. and *Stenopterocoris* China) which are represented by four oriental species and two African species of the former and one African species of the latter. *Prodromus* agrees with *Sulamita* in having a strongly convex regularly punctate pronotum, small scutellum, cuneus feebly delimited from corium, embolium very narrow and parallel sided and membranal cell very long, extending nearly to apex of cuneus. No doubt when the Miridae are better known there will be found in the Austro-Oriental region (Melanesia), connecting links between *Prodromus* and *Sulamita* which will better show how *Sulamita* and *Prodromus* have been related in the past. The posteriorly carinate vertex of *Sulamita* is very distinctive although *Stenopterocoris* has a similar very broad vertex posteriorly between the eyes. The latter are more prominent, almost pediculate in the Prodromini.

Genus **SULAMITA** Kirkaldy, 1902:129

There have been four species described thus far, but there are new forms in the collection studied. The status of *oreias* and *dryas* has been in doubt because Kirkaldy gave no adequate summary of diagnostic characters which would enable them to be recognized now. Usinger has pointed out to me that Perkins designated types from Kirkaldy's material after the latter's death, but that the new type localities do not agree with the localities cited by Kirkaldy; therefore Perkins' type designations appear to be invalid, but the problem requires further study.

Both macropterous and brachypterous forms occur.

Key to the Species of Sulamita

This key was prepared by W. E. China and is based upon the types in the British Museum.

1. Anterior lobe of pronotum yellow; puncturation of head very sparse along posterior margin, no distinct median line of punctures present; puncturation of pronotum relatively sparse ..... **opuna** Kirkaldy.

   Anterior lobe of pronotum black; puncturation of head relatively dense along posterior margin of vertex, a distinct median line of punctures present; puncturation of pronotum dense 2

2(1). Posterior lobe of pronotum yellow; hemelytra without brown markings except for a narrow brown border to apical margin of corium.....**dryas** Kirkaldy.

Black coloration extending over greater part of posterior lobe of pronotum; hemelytra with a distinct semicircular marking across both coria..... 3

3(2). Clavus black except for a narrow pallid border along claval commissure; first antennal segment longer than breadth of vertex between eyes.....**lunalilo** Kirkaldy.

Clavus mainly pallid with slight infuscation at base along claval suture; first antennal segment shorter than width of vertex between eyes.....**oreias** Kirkaldy.

Sulamita dryas has the relative lengths of antennal segments 1 and 2 as 32:72, whereas they are as 40:95 on *lunalilo*.

Sulamita dryas Kirkaldy (fig. 81, a).

Sulamita lunalilo, variety, Kirkaldy, 1902:130, pl. 4, fig. 12.
Sulamita dryas Kirkaldy, 1908:197.

Endemic. Hawaii (type locality: Kilauea).
A specimen in Perkins' collection at the Bishop Museum, collected by him at 3,000 feet on Lanai, was identified by Perkins as this species.

Sulamita lunalilo Kirkaldy (fig. 81, b).

Sulamita lunalilo Kirkaldy, 1902:130, pl. 4, figs. 12a, 14. Genotype.
Kirkaldy's pl. 4, fig. 12, applies to *S. dryas,* and fig. 13 to *oreias.*

Endemic. Kauai, Oahu, Lanai, Hawaii (type labeled "Makulaiia"; paratypes from Kona).
Hostplants: *Freycinetia, Xanthoxylum.*

Sulamita opuna Kirkaldy (fig. 81, d).

Sulamita opuna Kirkaldy, 1902:131.

Endemic. Oahu (type locality: Mount Kaala, 2,000 feet).
Hostplants: *Claoxylon, Pisonia, Xanthoxylum.*

Sulamita oreias Kirkaldy (fig. 81, c).

Sulamita oreias Kirkaldy, 1908:197.

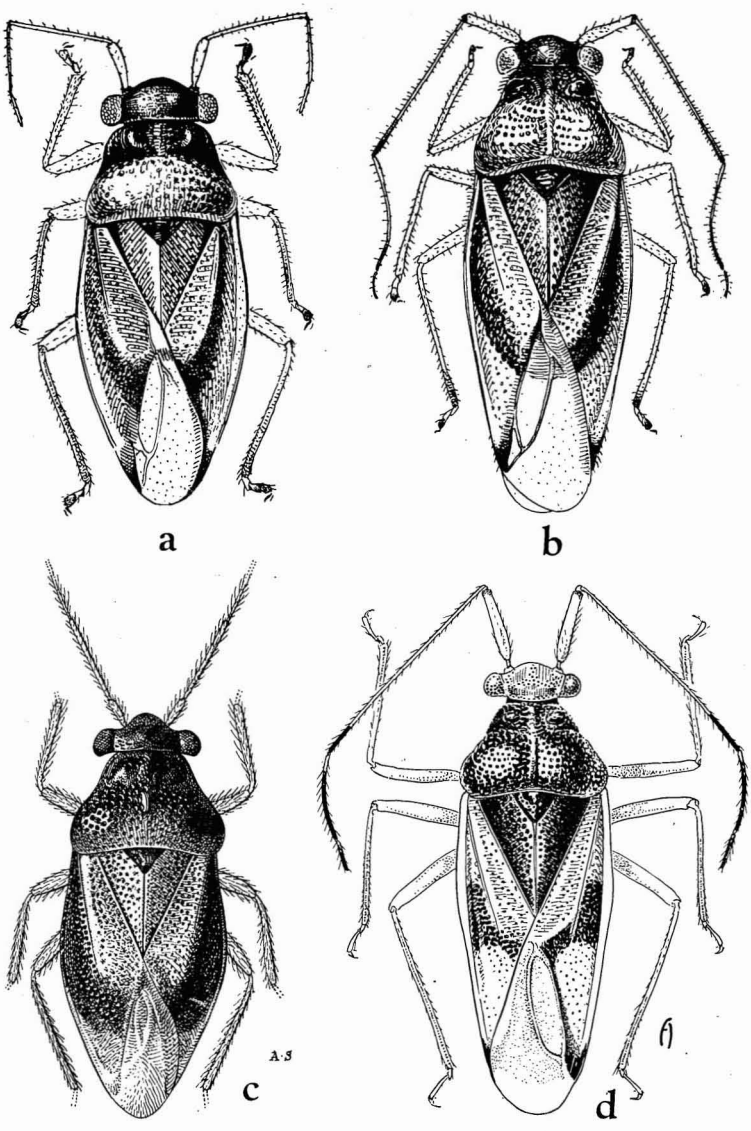

Figure 81—The species of *Sulamita*: **a**, *S. dryas* Kirkaldy (antennae reconstructed); **b**, *S. lunalilo* Kirkaldy; **c**, *S. oreias* Kirkaldy, holotype; **d**, *S. opuna* Kirkaldy. (Drawing **c** by Smith; others by Abernathy.)

Endemic. Kauai. No locality was given for this species by Kirkaldy, but the holotype bears Perkins' field number 631 which indicates that it was collected on Kauai on the "High Plateau, VIII '96."

Kirkaldy's 1902, pl. 4, fig. 13 belongs to this species, and the figured specimen will be the type. This example is illustrated herewith. A specimen bearing the following label is in Perkins' collection at the Bishop Museum: "Kauai 4000 ft. 1.02. *S. oreias* det RCLP."

Tribe KALANIINI, new tribe

This tribe is erected to receive our peculiar genus *Kalania* which has the pronotum margined at apex but without a collar; no hamus in cell of hind wing; fore wing with membrane areoles each divided into two areolets; tibiae not spinose; tarsi with first and second segments with longest chords subequal, third segment slightly swollen, slightly longer, the arolia fleshy and convergent. The antennae of the only known species has the first segment only one-fourth as long as the second which is longer than the following two together.

Genus **KALANIA** Kirkaldy, 1904:280

Baracus Kirkaldy, 1902:143, preoccupied.

Kalania is a peculiar genus. In our fauna it most closely resembles *Sarona,* next to which it was placed by Kirkaldy. It is easily distinguished from that genus, however, because it has a strongly protuberant scutellum and the tibiae are not spinose. As in *Sarona,* the head overlaps the apex of the pronotum, and the pronotum is margined at the apex where the base of the head fits against it. Only one species has been seen by me, and it is a rarity. Mr. China has kindly examined the type, and he agrees that a new tribe should be erected for it. He writes that it superficially might be placed in Reuter's division Perissobasaria (South America) because of the divided areoles of the fore wings which are unusual in the subfamily, but that the absence of a distinct pronotal collar on *Kalania* readily separates it from that group.

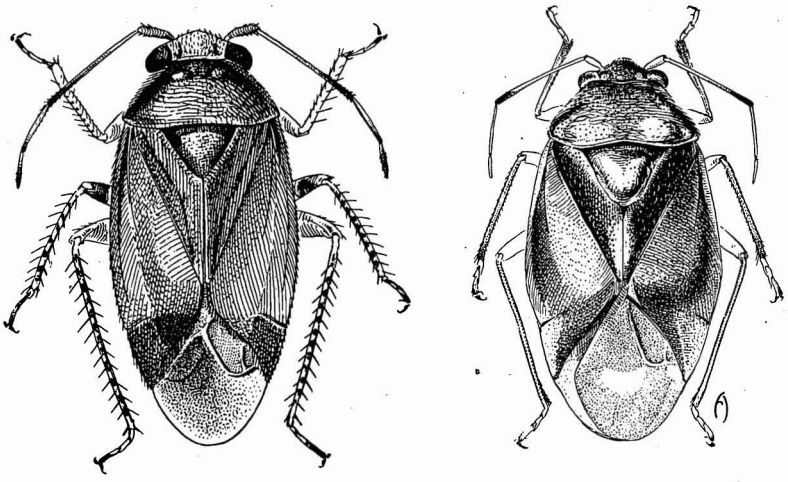

Figure 82—*Sarona adonias* Kirkaldy, left. *Kalania hawaiiensis* (Kirkaldy), right. (Drawn to same scale by Abernathy.)

Kalania hawaiiensis (Kirkaldy) (fig. 82).
Baracus hawaiiensis Kirkaldy, 1902:143, pl. 4, fig. 21.
Kalania hawaiiensis (Kirkaldy) Kirkaldy, 1904:280.

Endemic. Lanai (type locality: 2,000 feet).

Subfamily CYLAPINAE (Poppius, 1909)

A single immigrant species is the only representative of this group thus far recorded in Hawaii. The subfamily may be distinguished by the following combination of characters: head porrect, somewhat produced in front of eyes; areoles of hemelytral membrane entire; pronotum with a collar, not gibbose; tibiae setose but not spinose; tarsi without arolia. The group is mostly predaceous in habit.

Genus **FULVIUS** Stål, 1862

Fulvius is a cosmopolitan genus. Its members somewhat resemble lygaeids.

Fulvius peregrinator Kirkaldy (fig. 83).
Fulvius peregrinator Kirkaldy, 1910:120.

Kauai, Oahu, Hawaii. (Type locality not designated by Kirkaldy.)
Immigrant. I have collected it in Samoa, and it is probably more widely spread in the Pacific.

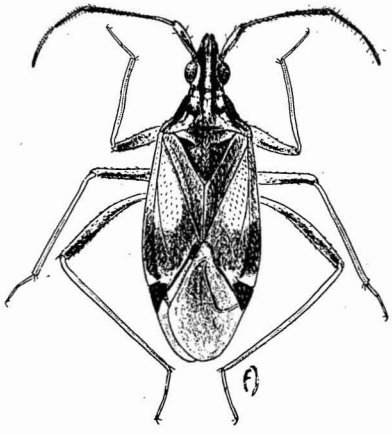

Figure 83—*Fulvius peregrinator* Kirkaldy. (Abernathy drawing.)

This species has been found in banana trash, sugarcane damaged by weevils and in similar places. It is evidently predaceous and probably has cryptic habits. A knowledge of the life history of this mirid is needed.

"Pemberton found a bug rather similar to this one that destroyed the eggs of a palm beetle-borer of the genus *Rhabdocnemis* in the Philippine Islands." (Williams, 1931:103.)

Subfamily HETEROTOMINAE Reuter, 1910

This is our most extensively developed mirid subfamily. It contains a number of complexes, is polymorphic, and is a difficult group. Because of the diverse groups of insects included, a brief, inclusive diagnosis of the subfamily is not easily written. The areoles of the hemelytral membrane are each divided into two cells (*Halticus* and *Nesidiorchestes* may lack the membrane, however); the pronotum lacks a collar; the tarsal arolia are present and usually finger- or flap-like (except in *Cyrtorhinus*, in which genus they are abnormally specifically variable); in *Pseudoclerada* the head is porrect, in the other genera it is deflexed.

Key to the Tribes of Heterotominae Found in Hawaii

1. Head porrect ..... **Pseudocleradini.**
   Head deflexed 2
2. Hind femora enlarged for leaping or head strongly embracing pronotum (anterior edge of pronotum covered by head) or both ..... **Halticarini.**
   Hind femora not enlarged for leaping; head usually obviously not overlapping fore edge of pronotum and fore edge of pronotum not extending anterior to hind edges of eyes (view from side) ..... **Heterotomini.**

Tribe HALTICARINI (Kirkaldy)

Division *Halticaria* Kirkaldy, 1902:139.

The genera *Halticus* and *Nesidiorchestes* include leaping insects with enlarged femora, especially prominent in *Nesidiorchestes*. The hind femora of the *Sarona* species are not so strongly expanded, and these bugs are not such characteristic jumping insects. The species of *Halticus* has long- and short-winged forms; the species of *Nesidiorchestes* is entirely brachypterous and cannot fly, and that of *Sarona* is always macropterous.

KEY TO THE GENERA OF HALTICARINI FOUND IN HAWAII

1. Membrane of hemelytra absent..... 2
Membrane of hemelytra present..... 3

2(1). First antennal segment not longer than greatest chord of an eye; dorsum with scattered, conspicuous ovate scales.... .....brachypterous **Halticus** Hahn.
First antennal segment distinctly longer than greatest chord of an eye; dorsum without scales..**Nesidiorchestes** Kirkaldy.

3(1). Head from top to apex of tylus much narrower than breadth across eyes; dorsum, excepting membrane, distinctly, densely punctate, without squamae; hemelytra with fracture slightly and indistinctly notched.....**Sarona** Kirkaldy.
Head as long as or slightly longer than broad; dorsum not distinctly punctate, with easily abraded, ovate, distinct squamae; hemelytra with fracture deeply, broadly, conspicuously emarginate.....macropterous **Halticus** Hahn.

Genus **NESIDIORCHESTES** Kirkaldy, 1902:139

This is a peculiar endemic genus of small, leaping bugs. The single species known is brachypterous, the hemelytra have no membrane, and the hind femora are greatly enlarged.

Nesidiorchestes hawaiiensis Kirkaldy (fig. 84).

Nesidiorchestes hawaiiensis Kirkaldy, 1902:139, pl. 4, figs. 15, 16. Genotype.

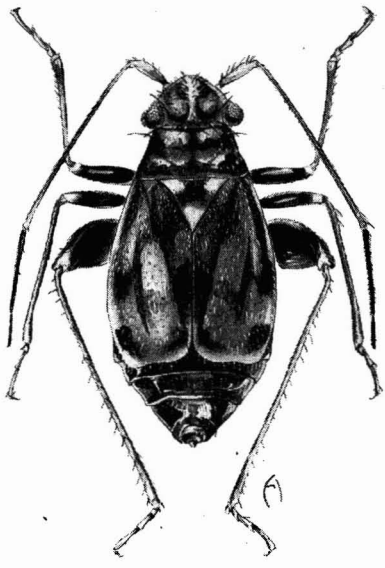

Figure 84—*Nesidiorchestes hawaiiensis* Kirkaldy. (Abernathy drawing.)

Endemic. Oahu (type locality: northwest Koolau Mountains, 2,000 feet).

I have collected this remarkable species by sifting dead leaves and ground litter in the mountains behind Honolulu. It is an agile and active jumper. I have seen it make leaps of about 1.5 inches high and 3 inches long in rapid succession.

Genus **HALTICUS** Hahn, 1832

Genotype: *Cicada aptera* Linnaeus, the only species included by Hahn.

A single immigrant species represents this genus in Hawaii. Both brachypterous and macropterous forms occur. The hind femora are greatly enlarged for leaping and the dorsum of the body has scattered, easily abraded squamae. This genus and *Nesidiorchestes* are our only genera in which the hind femora are so greatly swollen for leaping. However, they should not be easily confused, and the characters outlined in the key are ample for their separation.

If the exact date of publication of *Eurycephala* Laporte is established, that genus may replace *Halticus*.

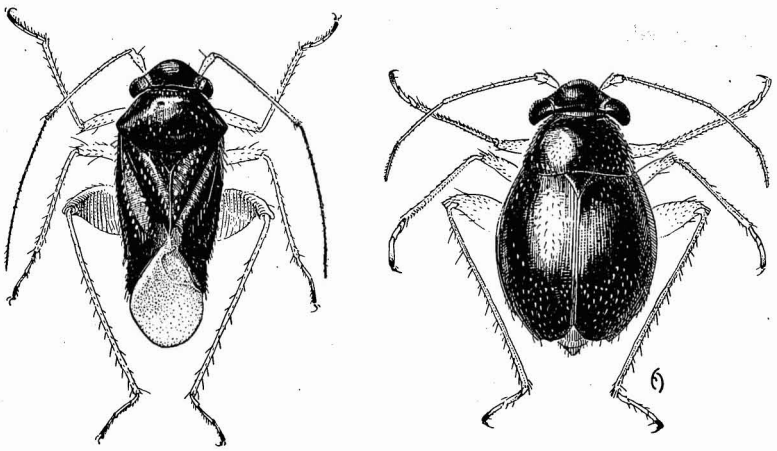

Figure 85—*Halticus chrysolepis* Kirkaldy, long- and short-winged forms. (Abernathy drawings; right figure eleven-tenths the size of the left.)

Halticus chrysolepis Kirkaldy (fig. 85).

Halticus chrysolepis Kirkaldy, 1904:179.

Oahu (type locality: Honolulu).

Immigrant. Source?

Hostplants: *Carex, Cynodon dactylon, Digitaria henryi,* "grasses."

This is a largely shiny black species, the hind femora are reddish-orange in life, and the dorsal squamae are iridescent green. It is often abundant in truck gardens.

The short-winged form may appear to one unfamiliar with the dimorphism to belong to a different genus from the long-winged form.

It is strange that this species has not yet been matched up with any of the species occurring elsewhere.

Genus **SARONA** Kirkaldy, 1902:142

This endemic genus is allied to no other in Hawaii, nor does it resemble any of our other mirids excepting *Kalania*. It appears to be an offshoot of Palearctic *Strongylocoris*. The body is stouter and more heavily sclerotized than in most of our other groups, the head is broad and short, the rostrum extends to or beyond the apex of the metacoxae, the hind femora are stout, and the entire insect has a distinctive facies that is apparent in the illustration.

Only one species has been described, but many new forms are in local collections. Perhaps more than a score of species will be described when the genus is studied carefully. The male genitalia display remarkable specific characters.

Sarona adonias Kirkaldy (fig. 82).

Sarona adonias Kirkaldy, 1902:142, pl. 5, fig. 23. Genotype.

Endemic. Molokai, Lanai, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:198).

Hostplants: *Metrosideros, Pelea.* Frequents flowers.

Tribe PSEUDOCLERADINI, new tribe

This tribe is erected for our peculiar endemic genus *Pseudoclerada* which Kirkaldy placed in his division Halticaria. Mr. China agrees that it cannot be retained in that tribe because of its unusual, porrect head. The cone-shaped head of the members of this tribe recalls that of certain predaceous bugs, and it is possible that this group has also developed a predaceous habit. The drawings show well the major characteristics of the tribe without the need of detailed explanation. The first two tarsal segments are subequal in length (measured along their greatest chords), the third segment a little longer than second; arolia convergent, membranous, finger-like. There is no hamus in the cell of the hind wing. Eyes very large, prominent; tylus protuberant. Pronotum without a collar.

Genus **PSEUDOCLERADA** Kirkaldy, 1902:140

This is one of our most peculiar bug genera, and its broad form combined with its porrect head will serve to distinguish it from the other mirids. Both macropterous and brachypterous forms occur.

Representatives of this genus have been collected on all of the main islands, and have been assigned to two species. I feel that confusion exists and that there are more than two species represented. There surely appear to be more than two species in the collections I have examined; perhaps almost every island has a distinct form. I have, therefore, questioned the locality records, other than the type localities, for the two described species. In answer to my request for information regarding the types in the British Museum, Mr. China sent the following comments:

I have examined the specimens of *Pseudoclerada morai* Kirk. in our collection and find that there are two species represented. The typical *P. morai* Kirk. has larger eyes in both sexes than *P. kilaueae* and the vertex between the eyes in the type male is very narrow. It is represented by the type male Molokai Mts. 3,000 ft. Perkins 1893, and three females—Honolulu, Oahu, 2,000 ft. Perkins 1896; 847 Hon. Mts. 12.1900; and Waialua, Koolau Range, Oahu, Perkins 1893. All the remaining specimens belong to a species with smaller eyes in both sexes (presumably *kilaueae* Kirk.). There is no specimen from Kilauea but there is a specimen labelled "figured" without precise locality, which could be regarded as the type (female). There are five other specimens including a male, which also has no precise locality. The remaining two specimens of *P. kilaueae* are from Kona, Hawaii, 4,000 ft., Perkins 1892, and Lanai, 2,000 ft. Perkins 1.1894. There is one broken specimen with head missing which cannot be identified. This makes thirteen specimens in all.

Kirkaldy did not have the specimen which China mentions as the female type of *kilaueae* before him when he described the species, for he was in Honolulu when he wrote the description which was based upon his figure in *Fauna Hawaiiensis*. It is the type, however, because it was the example used for the *Fauna Hawaiiensis* drawing.

Key to the Species of Pseudoclerada

Prepared from the types at the British Museum by Mr. W. E. China

1. Females. Vertex between eyes more than twice as wide as an eye (11:4.5) ..... **kilaueae** Kirkaldy.
   Vertex between eyes less than twice as wide as an eye (12:6.5) ..... **morai** Kirkaldy.
2. Males. Vertex between eyes at narrowest point, about two-thirds the width of an eye (7:9.5) ..... **kilaueae** Kirkaldy.
   Vertex between eyes at narrowest point one-half width of an eye (6:12) ..... **morai** Kirkaldy.

Pseudoclerada kilaueae Kirkaldy (fig. 86).

Pseudoclerada kilaueae Kirkaldy, 1908:198.

Kirkaldy's figure, 1902, pl. 4, fig. 19, applies to this species, not to *morai*.

Endemic. Lanai (?), Hawaii (type locality: Kilauea).

Kirkaldy's original description says only that "This has nothing to do specifically with *morai*, the eyes being much smaller, and the pattern and coloring quite dif-

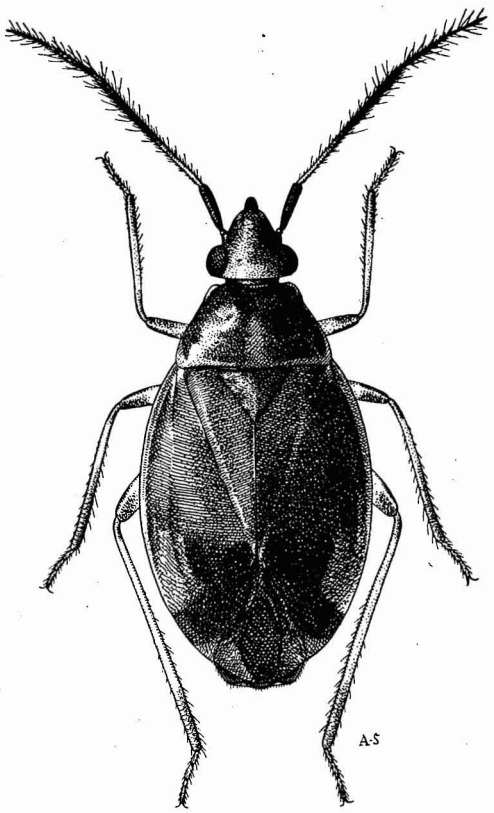

Figure 86—*Pseudoclerada kilaueae* Kirkaldy, holotype. (This is the same example as used by Kirkaldy, 1902, pl. 4, fig. 19, and misidentified there as *P. morai.*) (Drawn by Smith at the British Museum of Natural History.)

ferent." He may have come to the decision that this was a distinct species simply by examining his *Fauna Hawaiiensis* illustrations. This is a much smaller species than *morai.* The type in the British Museum is figured here.

Pseudoclerada morai Kirkaldy (fig. 87).

Pseudoclerada morai Kirkaldy, 1902:141, pl. 4, figs. 18, 18a.

Endemic. Kauai(?), Oahu(?), Molokai (type locality; Kirkaldy, 1908:198), Lanai(?), Maui(?), Hawaii(?).

Hostplants: *Elaeocarpus, Freycinetia, Pipturus, Tetraplasandra.*

Specimens have been found under dead bark and in hollow stems. The species may be predaceous, but nothing is known of its habits.

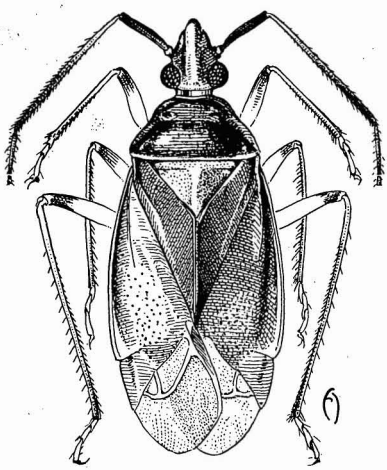

Figure 87—*Pseudoclerada morai* Kirkaldy. (Note: The "neck" is not always visible as is shown here.) (Abernathy drawing.)

Perkins (1913:ccii) noted that "There is great sexual difference in the development of the eyes, and brachypterous forms occur. The species inhabits damp shady places in the forest and has been found beneath bark of dead branches of trees, and also amongst the moss or creeping ferns growing on these. Like *Metrarga,* they hide at the bases of the leaves of *Freycinetia,* where rubbish accumulates."

Tribe HETEROTOMINI (Kirkaldy)

Division *Heterotomaria* Kirkaldy, 1902:132.

The members of this widespread group have a distinctive facies which is well displayed by the illustrations. I am not sure that *Koanoa* is correctly placed here.

Key to the Genera of Heterotomini Found in Hawaii

1. Rostrum extending behind metacoxae..... ..... **Kamehameha** Kirkaldy.
   Rostrum not reaching behind metacoxae..... 2
2(1). Hind margin of head not vertical, but horizontal, most posterior part shiny and somewhat narrowly "neck-like" ..... **Cyrtorhinus** Fieber.
   Hind margin of head vertical or nearly so, not neck-like, fitting closely to pronotum..... 3
3(2). Second antennal segment not reaching beyond posterior edge of pronotum; fracture of hemelytra deeply and conspicuously emarginate .....**Koanoa** Kirkaldy.
   Second antennal segment reaching to far beyond posterior edge of pronotum; fracture of hemelytra usually shallowly emarginate.....**Orthotylus** Fieber.

Genus **CYRTORHINUS** Fieber, 1858

Cyrtorrhinus (Fieber) Reuter, 1884.
Genotype: *Capsus caricis* Fallen, the only species included by Fieber.

Two imported species represent this almost cosmopolitan genus in Hawaii. Usinger (1939:271–273) reviewed the distribution and host relationships and gave notes on the habits of the group. The genus is an economically important and valuable one, for its species feed upon the eggs of delphacid leafhoppers and are thus beneficial.

These bugs somewhat resemble *Nesiomiris,* but they lack the pronotal collar of that genus. "An apparent structural anomaly in *Cyrtorhinus* which has not been given sufficient attention is the absence, in certain species, of arolia between the claws. In such cases two very fine, small, parallel setae are the only structures to be seen between the claws. The presence or absence and form of the arolia is usually a very reliable guide to relationships in the Miridae . . ." (Usinger, 1939:272.) Our species *fulvus* has distinct arolia, whereas our *mundulus* has the paired setae. This is the only genus of the subfamily with such known variability.

In addition to the following two species, *C. lividipennis* Reuter was introduced by the Board of Agriculture and Forestry from Guam in 1939. It is a predator on the eggs of the corn leafhopper and is widespread in the Indo-Pacific. Unfortunately, that species has not become established here.

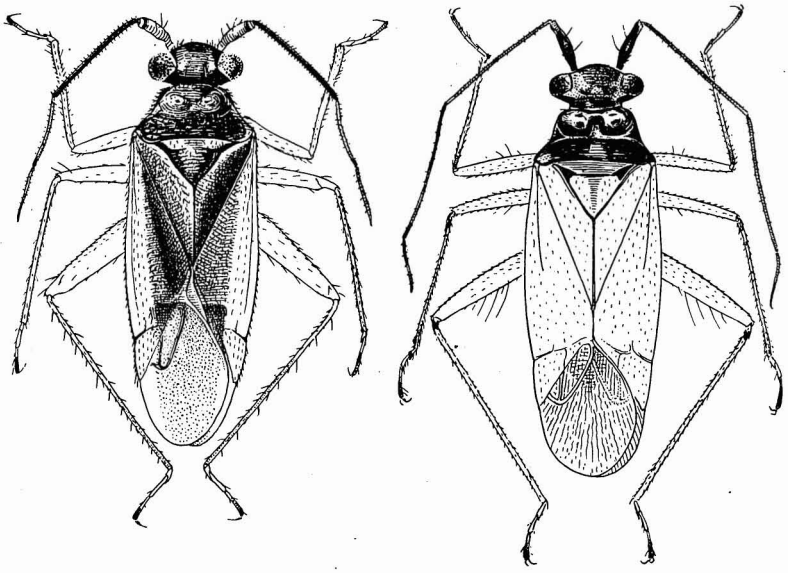

Figure 88—*Cyrtorhinus mundulus* (Breddin), the sugarcane leafhopper egg-sucking bug, left. *Cyrtorhinus fulvus* Knight, the taro leafhopper egg-sucking bug, right. (Drawn to same scale by Abernathy.)

KEY TO THE SPECIES OF CYRTORHINUS FOUND IN HAWAII

1. Head, thorax and abdomen mostly or entirely black; first antennal segment mostly yellow; fore wings in part fuscous, clavus almost black, outer wing edges pale, hyaline or subhyaline, closed wings appearing to be blackish down middle with whitish borders.....**mundulus** (Breddin).

2. Head and prothorax mostly black, remainder of thorax and abdomen orange; scutellum orange with a black median line; first antennal segment mostly black; fore wings orange, conspicuously contrasting with black pronotum.....**fulvus** Knight.

Cyrtorhinus fulvus Knight (fig. 88).
Cyrtorhinus fulvus Knight, 1935:205.

Oahu.

The taro leafhopper egg-sucking bug.

Purposely introduced to Hawaii in 1938 for the purpose of aiding in the control of the taro leafhopper, *Tarophagus proserpina.* Recorded from Java, the Philippines, Fiji and Samoa. Fullaway sent the first specimens to Hawaii from the Philippines, and they were liberated in taro patches near Kaneohe, Oahu.

Cyrtorhinus mundulus (Breddin) (figs. 88; 89, a–d).
Periscopus mundulus Breddin, 1896:106; genotype of *Periscopus.*

Kauai, Oahu, Molokai, Maui, Hawaii.

The sugarcane leafhopper egg-sucking bug.

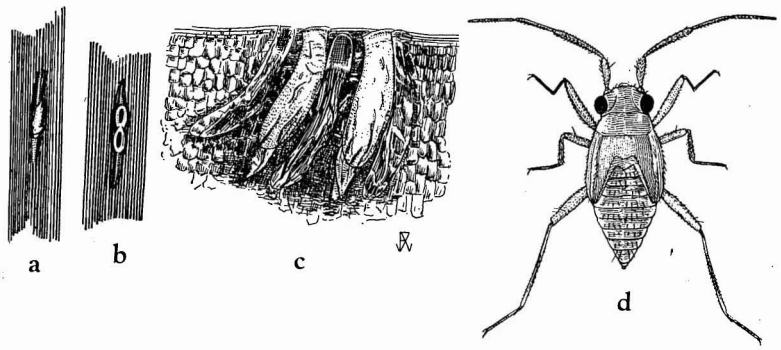

Figure 89—*Cyrtorhinus mundulus* (Breddin): **a,** an egg puncture of the sugarcane leafhopper in a sugarcane leaf; **b,** ends of two eggs of *Cyrtorhinus* protruding from an old leafhopper egg puncture; **c,** a section through the midrib of a sugarcane leaf to expose two unhatched *Cyrtorhinus* eggs inserted in a leafhopper egg slit among remnants of the leafhopper eggs; **d,** nymph. (**a–c,** after Williams, 1931.)

Purposely introduced from Queensland and Fiji in 1920 to aid in the control of the sugarcane leafhopper, *Perkinsiella saccharicida.* Known from Java (type locality), the Philippines, Australia and Fiji.

The introduction of this species, its subsequent successful establishment and the great good it has done is one of the most outstanding records in the history of biological control. This one bug has saved the Hawaiian sugar industry and the Territory millions of dollars—its true worth can hardly be estimated. Many people, I fear, have forgotten all too soon the ravages of the sugarcane leafhopper and how the failure of the sugar industry of the islands was averted by the successful control of the leafhopper by the concerted efforts of the faithful workers of the Experiment Station, H.S.P.A., at Honolulu.

An entire chapter could be devoted to the story surrounding this bug in Hawaii. There are those who were active during the establishment of control of the sugarcane leafhopper and who have already written excellent accounts. I can do no better here than to quote from Dr. Swezey's excellent report "Biological Control of the Sugar Cane Leafhopper in Hawaii" (1936:79–81) as follows:

When in Queensland in 1920 in search of additional natural enemies for the sugar cane leafhopper, Dr. Muir discovered that the little mirid bug, *Cyrtorhinus mundulus,* had the habit of piercing and sucking leafhopper eggs, and was the most efficient control agent of that pest. Although belonging to a family of bugs which are chiefly plant feeders, it seemed never to suck plant tissues. A small colony of the bugs was brought to Honolulu, and later in the year larger consignments were obtained and sent from Fiji by C. E. Pemberton. The bug had previously been known by Dr. Muir in Fiji cane fields without his having learned its habits. Three consignments were received from Fiji in September, October, and November 1920, and consisted of adults and young in cages with growing cane and leafhoppers. Several hundreds of the bugs were received in this manner. Some were released in plantation fields infested with leafhoppers, others were used for breeding in cages; breeding was kept up for a year. From the breeding cages many hundreds of bugs were obtained for distribution to the regions where the leafhoppers were most abundant. The bug readily became established in these places and spread from them throughout the entire sugar cane area and even reached Maui and Molokai without assistance. The first recovery was at Olaa only a month after liberation (their eggs were found in leafhopper-infested cane leaves sent in for examination). During the following year (1921) a few scattering recoveries were made and it seemed doubtful if the bug were becoming established sufficiently to be of any importance. In March 1922, the bugs were found very abundant at Ewa Plantation, at Waialua and at Olaa. During the year it was found sparsely in many regions, and during 1923 was found to be generally distributed throughout all the cane regions. The leafhopper was now almost entirely reduced, this bug proving to be more efficient in destroying the leafhopper eggs than were the egg parasites. In fact, without doubt, *Cyrtorhinus* caused a reduction in the efficiency of the egg parasites for it sucked leafhopper eggs regardless of whether they were already parasitized or not. In a few more years, with the scarcity of the leafhoppers, it became difficult to find the egg parasites in the fields or parasitized leafhopper eggs. At this time (from 1923 on) the control of the leafhopper was considered to be complete, having finally reached this condition through the introduction and establishment of the *Cyrtorhinus,* which had increased to great abundance wherever there were leafhopper eggs. As outbreaks of leafhoppers were reduced by the *Cyrtorhinus,* the latter disappeared also, to appear again and increase to abundance wherever any new outbreaks of leafhopper occurred. It was considered by the entomologists that if this had been the first to be introduced, it would by itself have been sufficient for the control of the leafhopper....

Their favorite habitat is within the spindle of the cane plant and when very numerous they were also found among the bristles of the leafsheath. Under favorable conditions *Cyrtorhinus* may produce ten generations per year.

Dr. Williams (1931:103–104) includes the following descriptive information in his discussion of the species:

The adult Cyrtorhinus is about 3 millimeters long; the general color is black, with the body in part (beneath the wings) reddish in males and in all young adults, the legs and the base of the antennae are pale and the light smoky wings have a broad whitish front border. It seeks the eggs of the leafhopper and sucks them through a minute puncture which it makes with its slender beak. Wary and exceedingly active, it is usually approachable only with caution, otherwise it will dodge behind a leaf or stem or make a hasty flight to the next plant. The eggs are inserted into small crevices in the cane leaf, a leafhopper egg-slit being frequently chosen; they are of shorter and stouter form than those of the leafhopper and occur singly or in very small groups. Rather close scrutiny is required for their discovery, when they may be recognized, where they are exposed, flush with the surface of the leaf, as rather evenly oval white discs or caps, the center of which is sunken and dark giving them a ring-like appearance in contrast to the irregularly protruding, waxy covering that protects the tips of the leafhopper eggs. The young Cyrtorhinus are rather short, and bright red and suggest somewhat red spiders or mites of the genus Trombidium; they may often be seen in and about the spindles of the sugar cane plant, under favorable conditions, to the number of 50 or more; they are brisk runners and undoubtedly suck dry many a leafhopper egg apiece. In the last moult the vivid coloration disappears and the duller, fully winged adult now appears.

Genus **ORTHOTYLUS** Fieber, 1858

Tichorhinus Fieber, 1858.
Genotype: *Cimex nassatus* Fabricius, fixed by Kirkaldy, 1906.

This nearly cosmopolitan genus contains a larger number of described species in Hawaii than any other genus of local mirids. There are, however, many new species awaiting description in our collections. It would not be surprising to me to see 50 or more species described in this genus. Careful collecting and revisional study may show that this group rivals the *Nysius* complex in its diversification and development. The species are small, soft and delicate. Many of them are brightly colored and have striking color patterns. Some are brilliant green, others are bright red, some are conspicuously maculate, while others are somber in color with obscure markings. They closely resemble members of the genus *Psallus,* and one *Psallus* has been described in this genus. However, the genera belong to different subfamilies, as outlined in the key. *Orthotylus* has the tarsal arolia convergent, finger-like or flap-like, whereas these structures are wanting or indistinct in *Psallus.*

I have taken several species at light in the native forests. Perkins (1913:ccii) noted that "The nymphs are often abundant on the under side of the leaves of the trees, in company with the adults. Unless disturbed by shaking, very rarely are any of the latter seen on the wing." Native plants occasionally swarm with them.

The following preliminary key has been expanded from Kirkaldy's key (1920: 132–133), and with the aid of Dr. Usinger, who worked on it during a visit to my office in 1943, and of Mr. China, who checked it with the types at the British Museum and made some valuable changes and additions. It is based upon color for want of knowledge of the other characters of the group. The male genitalia display excellent differential characters, but insufficient authentically determined material has been at hand to enable us to use those structures here. It need hardly be mentioned further that this large, complex group is too poorly known at present for us to more than indicate what has been done and to suggest what remains to be done.

Key to the Hawaiian Orthotylus

1. Color largely reddish 2
   Color largely greenish, yellowish testaceous or fuscous (sometimes with a slight reddish tinge, but never distinctly red) 3

2(1). Cuneus entirely red, pale only along fracture..... ..... **kekele** Kirkaldy.
   Cuneus broadly white at base and narrowly so at apex.... ..... **daphne** Kirkaldy.

3(1). Uniformly greenish or testaceous, immaculate..... 4
   Always more or less infuscated..... 5

4(3). Pale green; pubescence entirely pale.....**iolani** Kirkaldy.
   Bluish green; pubescence brownish.....**perkinsi** Kirkaldy.

5(3). Pronotum pallid testaceous (sometimes speckled with red anteriorly), with a distinct, dark brown, triangular mark in middle, its base along posterior margin and its apex just extending onto base of vertex of head..... ..... **azalais** Kirkaldy.
   Pronotum without such a fuscous mark..... 6

6(5). Head, pronotum and inner apices of coria immaculate..... .....**tantali** (Perkins).
   Head, pronotum and inner apices of corium with fuscous markings 7

7(6). Cuneus with a dark red band across apical half leaving extreme apex and basal half pale pink; apical margin of corium surrounding cuneus pale pink; veins of membrane red; pronotum in female largely blackish..... .....**kassandra** (Kirkaldy).
   Cuneus uniformly pale (female) or with only an apical marginal infuscation (male) which is sometimes reddish; veins of membrane brown; pronotum of female with a large, pallid, median, anterior area.....**kanakanus** Kirkaldy.

The hostplant lists are obviously incomplete, and I feel that some of them may be inaccurate because of misidentification of the bugs.

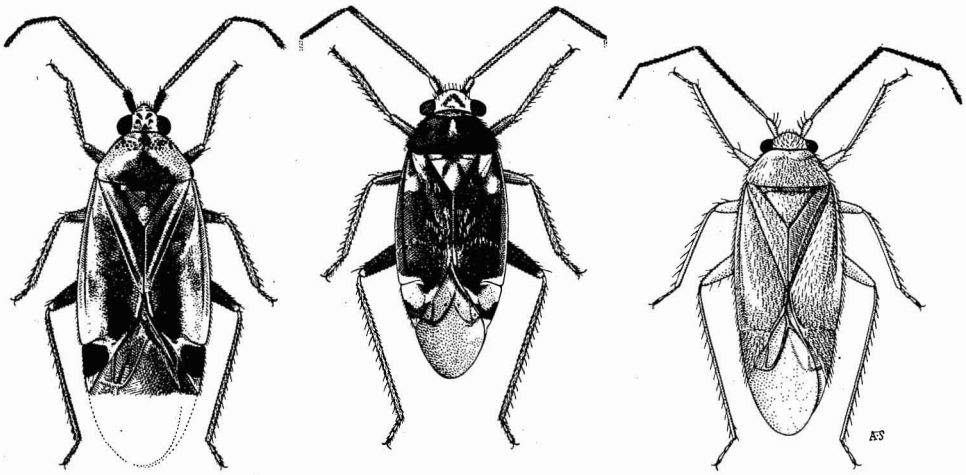

Figure 90—Holotypes of *Orthotylus azalais* Kirkaldy, left; *O. daphne* Kirkaldy, middle; *O. iolani* Kirkaldy, right. (Drawn at the British Museum of Natural History by Smith.)

Orthotylus azalais Kirkaldy (fig. 90).

Orthotylus azalais Kirkaldy, 1902:136, pl. 5, fig. 26.

Endemic. Kauai (type locality: Makaweli, 2,000 feet; Kirkaldy, 1908:198).

Hostplants: *Coprosma, Gouldia.*

The males and females differ in color pattern. The damaged type, figured here, is in the British Museum.

Orthotylus daphne Kirkaldy (fig. 90).

Orthotylus daphne Kirkaldy, 1902:135, pl. 5, fig. 24.

Tichorhinus daphne (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Oahu (type locality: Waianae; Kirkaldy, 1908:198).

Hostplant: *Xylosma.*

The type is in the British Museum and is figured here.

Orthotylus iolani Kirkaldy (fig. 90).

Orthotylus iolani Kirkaldy, 1902:133.

Tichorhinus iolani (Kirkaldy) Kirkaldy, 1908:197.

Endemic. Oahu, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:197).

Hostplants: *Clermontia, Hibiscus, Pipturus albidus* (sometimes and in some places abundant on the leaves), *Sophora.*

Our figure was made from the type at the British Museum.

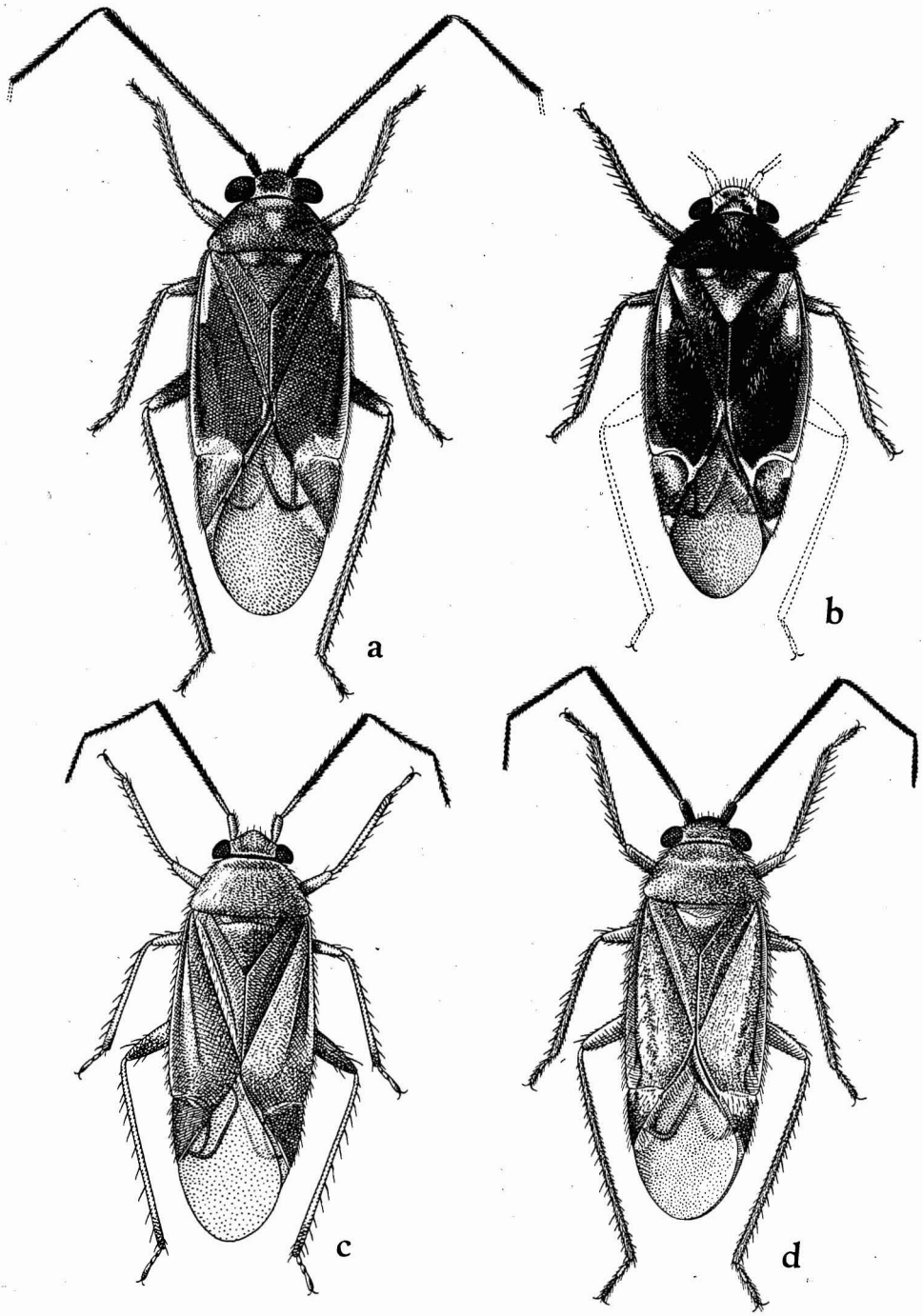

Figure 91—Holotypes of *Orthotylus*: **a**, *O. kanakanus* Kirkaldy; **b**, *O. kassandra* (Kirkaldy); **c**, *O. kekele* Kirkaldy; **d**, *O. perkinsi* Kirkaldy. (Drawn by Smith at the British Museum of Natural History.)

Orthotylus kanakanus Kirkaldy (fig. 91, a).

Orthotylus kanakanus Kirkaldy, 1902:134, pl. 5, fig. 27.
Tichorhinus kanakanus (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Oahu, Lanai, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:198).

Hostplants: *Pipturus albidus, Straussia.*

Mr. China reports that the type male (figured here) and cotype female under this name at the British Museum are teneral specimens, but that Kirkaldy had labeled the mature examples *"persephone,"* a name he did not publish. There is sexual dimorphism in color in this species.

Orthotylus kassandra (Kirkaldy) (fig. 91, b).

Orthotylus daphne variety *kassandra* Kirkaldy, 1902:135, pl. 5, fig. 25.
Tichorhinus kassandra (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Kauai, Oahu, Molokai, Lanai, Hawaii (type locality: Kilauea; Kirkaldy, 1908:198).

Hostplants: *Acacia koa, Alyxia, Ipomoea, Sadleria, Straussia, Pipturus.*

The British Museum type is illustrated here.

Orthotylus kekele Kirkaldy (fig. 91, c).

Orthotylus kekele Kirkaldy, 1902:134, pl. 5, fig. 28.
Tichorhinus kassandra (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Kauai (type locality: "High Plateau").

Hostplants: *Broussaisia, Pipturus.*

The type is in the British Museum and is figured here.

Orthotylus perkinsi Kirkaldy (fig. 91, d).

Orthotylus perkinsi Kirkaldy, 1902:133.
Tichorhinus perkinsi (Kirkaldy) Kirkaldy, 1908:197.

Endemic. Kauai, Oahu, Lanai, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:197).

Hostplant: *Sophora.*

Our illustration was made from the type in the British Museum.

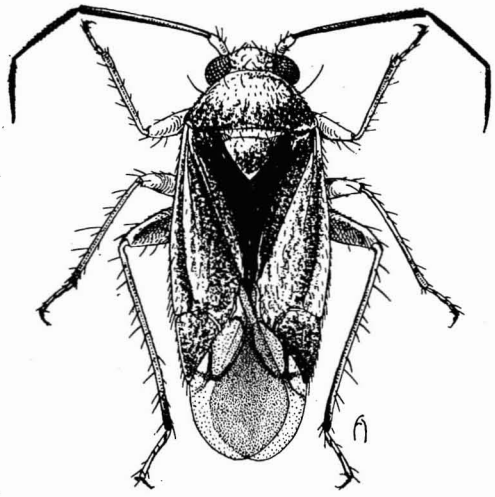

Figure 92—*Orthotylus tantali* (Perkins). (Drawing by Abernathy.)

Orthotylus tantali (Perkins), new combination (fig. 92).
Tichorhinus tantali Perkins, 1912:730, fig. *B*.

Endemic. Oahu (type locality: Mount Tantalus).
Hostplant: *Pipturus* (abundant at times).
The type is in the Bishop Museum.

Genus **KAMEHAMEHA** Kirkaldy, 1902:137

In our fauna, this native genus appears to include a large *Orthotylus* but the rostrum extends beyond the metacoxae, and the median line of the head is impressed. It closely resembles the large, widespread genus *Phytocoris*. It is, of course, named after the great Hawaiian, King Kamehameha I. Additional species will perhaps be discovered and described in this genus.

Kamehameha lunalilo Kirkaldy (fig. 93).
Kamehameha lunalilo Kirkaldy, 1902:137, pl. 5, fig. 22. Genotype.

Endemic. Oahu (type locality: Waianae; Kirkaldy, 1908:198).
Hostplants: *Cyrtandra, Pipturus*.
This species, named in honor of King Lunalilo, is a rather striking member of our Miridae. It is mottled and spotted, principally with browns, yellows and reds when dried, and the legs and antennae are long. The hemelytral membrane extends beyond the apex of the abdomen for a distance greater than the length of the venter behind the metacoxae.

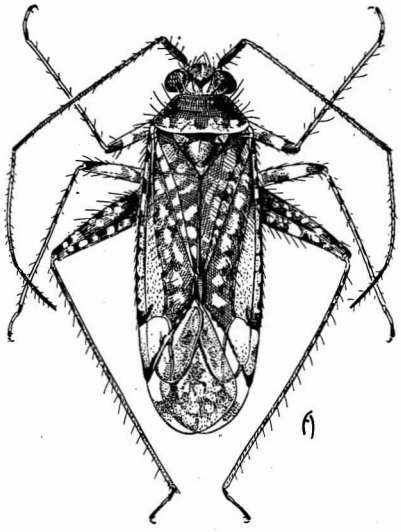

Figure 93—*Kamehameha lunalilo* Kirkaldy. (Abernathy drawing.)

It is "chiefly to be found in damp forests, living on the mosses or creeping ferns, which clothe the trunks and branches in such situations. Consequently it may be obtained from many kinds of trees by indiscriminate beating of the branches." (Perkins, 1913:ccii.)

Genus **KOANOA** Kirkaldy, 1902:136

The two species thus far described in this native genus somewhat resemble convex, black, submetallic *Orthotylus*. However, they differ from *Orthotylus* by having the second antennal segment much shorter and not passing the hind pronotal margin (it far surpasses the hind margin in *Orthotylus*), by having a short rostrum which does not extend onto the apices of the mesocoxae, and by having the outer edge of the hemelytral fracture comparatively deeply and conspicuously emarginate. They also vaguely suggest small species of *Sarona*. The longitudinal dorsal contour is unusual, as the illustration shows. There are several new species before me. Mr. China tells me that he feels that the genus is "far from being a typical Heterotomid."

Key to the Species of Koanoa

1. Second antennal segment concolorous, entirely yellowish; setae on disc of pronotum and hemelytra comparatively appressed and shorter and of different type than those of second antennal segment.....**hawaiiensis** Kirkaldy.
2. Second antennal segment partially (female) or entirely (male) black; setae on disc of pronotum and hemelytra long and about as long as those on second antennal segment, those on pronotum and scutellum comparatively erect, bristling.....
.....**williamsi** Usinger.

Koanoa hawaiiensis Kirkaldy (fig. 94).
Koanoa hawaiiensis Kirkaldy, 1902:136.

Endemic. Kauai, Oahu, Molokai, Lanai (type locality: Kirkaldy, 1908:198), Maui, Hawaii.

Hostplants: *Acacia koa, Bidens cosmoides, Cheirodendron, Metrosideros, Sideroxylon, Styphelia* (*Cyathodes*).

The above distribution follows Kirkaldy, but there is reason to believe that more than one species was included in his type series.

Koanoa williamsi Usinger (fig. 94).
Koanoa williamsi Usinger, 1937:437.

Endemic. Oahu (type locality: Mount Lanihuli).

Hostplant: *Freycinetia* (not uncommon "... between and at the bases of the clasping leaves particularly toward the top of the leaf cluster where the youngest and tenderest foliage is to be found." Usinger, 1937:437).

Usinger described the first, second, fourth and fifth nymphal instars.

Subfamily MIRINAE (Reuter, 1910)

Two genera represent this subfamily in Hawaii. They are our most elongate native Miridae and are easily recognized. The two Hawaiian groups are easily distinguished as follows:

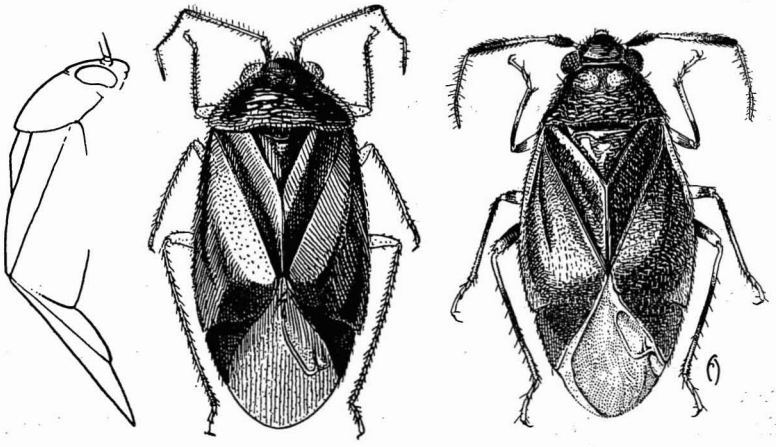

Figure 94—*Koanoa hawaiiensis* Kirkaldy, left (with side view of dorsal outline). *Koanoa williamsi* Usinger, left. (Abernathy drawings.)

1. Head porrect, more or less cone-shaped, elongate..... ..... **Oronomiris** Kirkaldy.
2. Head deflexed, broad.....**Nesiomiris** Kirkaldy.

Genus **ORONOMIRIS** Kirkaldy, 1902:144

In addition to the single described species, there are new species before us, some of which are peculiar brachypterous forms. They resemble closely the widespread genus *Trigonotylus* Fieber. The only Hawaiian group with which they might possibly be associated after a cursory glance is *Nesiomiris,* because of similar size and their elongate, slender bodies. Their heads, however, are peculiar, porrect, rather cone-shaped, the eyes are not strongly protuberant and hardly extend beyond the sides of the front of the pronotum, the tylus is peculiarly and strongly produced and compressed.

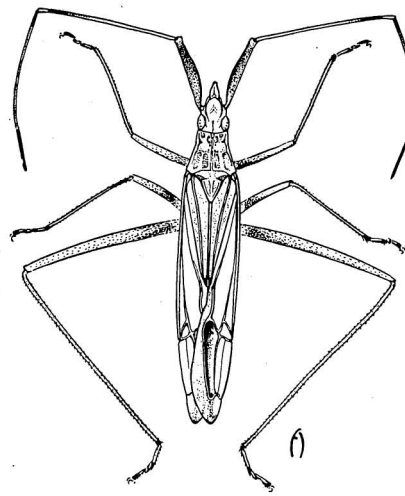

Figure 95—*Oronomiris hawaiiensis* Kirkaldy. (Abernathy drawing.)

Oronomiris hawaiiensis Kirkaldy (fig. 95).

Oronomiris hawaiiensis Kirkaldy, 1902:144, pl. 5, fig. 30. Genotype.

Endemic. Kauai, Oahu (type locality: Waimea; Kirkaldy, 1908:198), Lanai, Maui, Hawaii, Laysan.

Hostplants: native grasses (abundant at times), Bermuda grass, *Sporobolus virginicus.*

Perkins (1913:cc–cci) stated that he found it to be "a very abundant species on foreign grasses, [and it] occurs everywhere in suitable places, from the coast to 5000 ft. or more in the higher islands. This will, I think, almost certainly be found

outside the islands though possibly a natural immigrant." The discovery of new species of the genus now places this species on the endemic list, however, and I feel that there is a mixture of species in the series from which the above data have been derived.

Genus **NESIOMIRIS** Kirkaldy, 1902:144

This endemic genus is allied to the widespread *Teratocoris* Fieber. Although only the genotype has been described, there has been assembled in local collections a whole series of splendid new species which now await description. Perhaps several dozen species will eventually be discovered. The male genitalia display remarkable structural differences. The group contains some of our largest Miridae, and they are readily recognized by their comparatively large size and their slender, elongate forms. The species are mostly green, drying to yellows and pale browns. I have examined specimens from all of the main islands.

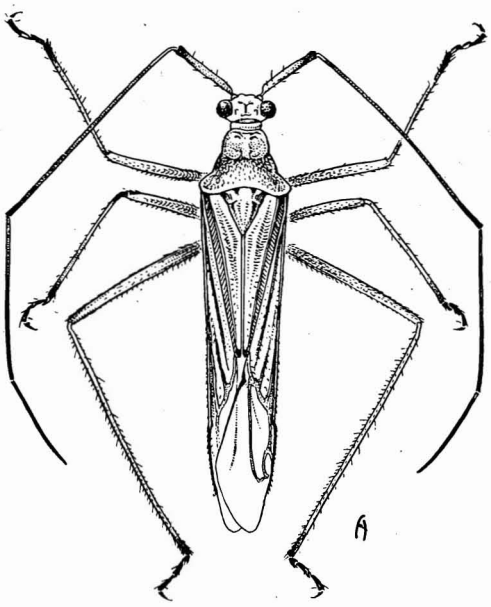

Figure 96—*Nesiomiris hawaiiensis* Kirkaldy. (Abernathy drawing.)

Nesiomiris hawaiiensis Kirkaldy (fig. 96).

Nesiomiris hawaiiensis Kirkaldy, 1902:145, pl. 5, fig. 50. Genotype.

Endemic. Hawaii (type locality: Olaa; type labeled *N. kekele* in error, Kirkaldy, 1908:198).

Hostplants: *Byronia, Cheirodendron gaudichaudi, Reynoldsia, Tetraplasandra hawaiiensis.* There may be errors in this list because of misidentifications of the bugs.

It is probable that the type series contained more than one species, and although the species has been recorded from Oahu, Molokai, Lanai and Maui, I believe that it may be confined to Hawaii.

Subfamily CAPSINAE (Reuter, 1883)

The combination of conspicuously collared prothorax, strongly divergent tarsal arolia and hemelytral cell divided into two areoles suffices to separate this group from all others in Hawaii.

Key to the Genera of Capsinae Found in Hawaii

1. Fore wings for most part transparent, hind wings and abdomen distinctly visible through them; clavus and corium mostly without coarse punctures and with fine setae confined mostly to margins; antennae nearly as long as body..... .....**Hyalopeplus** Stål.
2. Fore wings opaque; clavus and corium entirely covered with dense, rather coarse setiferous punctures; antennae only about one-half as long as body.....**Lygus** Hahn.

Genus **HYALOPEPLUS** Stål, 1870

This genus is largely confined to the Indo-Pacific area but it extends to the Ethiopian region. It is abundantly represented in the southern and western Pacific islands.

Hyalopeplus pellucidus (Stål) (fig. 97).

Capsus pellucidus Stål, 1859:255.

Kauai, Oahu (type locality: Honolulu), Molokai, Lanai, Maui, Hawaii.

Immigrant. Also known from the Society Islands.

Hostplants: *Acacia koa,* coffee, *Coprosma, Dodonaea,* avocado (breeds in the inflorescence), guava, *Hibiscus* (the common host in the lowlands), *Metrosideros, Pipturus, Sida, Straussia.*

This is a common insect which ranges from the seashore to several thousands of feet into the mountains. It is occasionally collected about lights. It is our most bulky mirid, and reaches a length of 8 to 10 mm. Kirkaldy (1907:159) described the fourth and fifth stage nymphs. It is variable in color; some individuals are

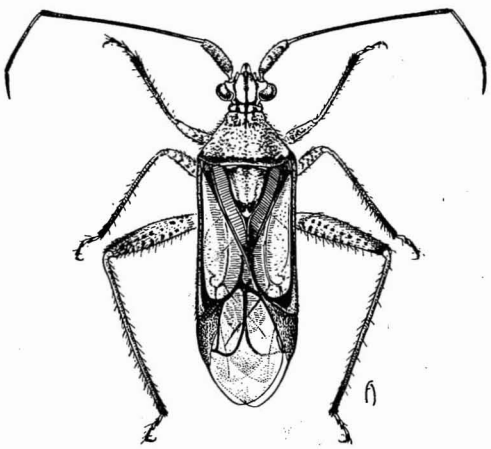

Figure 97—*Hyalopeplus pelucidus* (Stål). (Abernathy drawing.)

much darker than others. Kirkaldy (1904:185) noted that "It is predaceous and should not be destroyed." Its feeding habits are unknown, however, and some observers believe that it is phytophagous.

Genus **LYGUS** Hahn, 1831

This is a large, nearly world-wide, difficult-to-work-with genus. Although a number of species occur in the southwest Pacific and as near to Hawaii as Samoa, the genus has not reached Hawaii by natural means. A single American species, however, has recently been accidentally imported to our islands.

The genus is easily separated from all our other mirids by the characters summarized in the key to the genera and by the distinctive features of the subfamily. The convex, coarsely punctured dorsum might lead one to associate it with some of our Bryocorinae, but the presence of a collar on the pronotum is a conspicuous character for use in the easy separation of the two groups.

Lygus elisus (Van Duzee) (fig. 98).

Lygus pratensis variety *elisus* Van Duzee, 1914:20.

Lygus elisus (Van Duzee) Van Duzee, 1917:347. Knight, 1917:574, fig. 165 (genitalia). Shull, 1933:1–42, figs. 1–3.

The pale legume bug.

Immigrant. Described from California and widespread in western United States. First discovered in Hawaii in material taken in a light trap set up at Iroquois Point, Pearl Harbor, by Hawaiian Sugar Planters' Association entomologists in July, 1947.

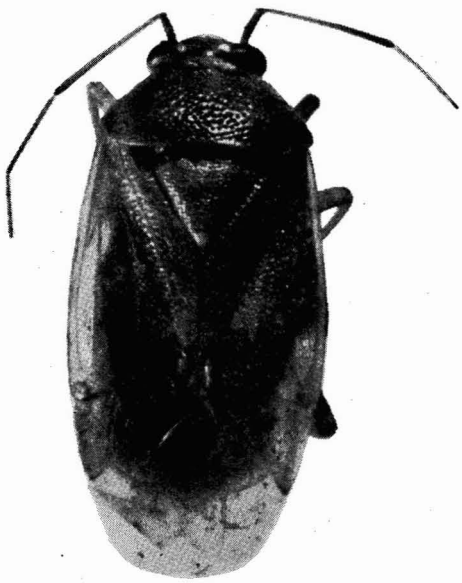

Figure 98—*Lygus elisus* (Van Duzee), the pale legume bug.

Hostplant: *Chenopodium album.*

Although we have found it only on one hostplant in Hawaii, we expect it to attack a number of other plants here, and it may become a pest of considerable economic importance. Shull (1933) lists the following as hostplants in Idaho: *Amaranthus retroflexus, Beta vulgaris, Chenopodium album, Daucus carota, Medicago sativa, Melilotus albus, Phaseolus vulgaris, Plantago major, Polygonum aviculare, Pyrus malus, Rumex crispus, Salsola pestifer, Seratina pitcheri, Solanum nigrum, Trifolium pratense, Trifolium repens.*

Shull (1933) states that the injury to beans "appears as a small hole in the seed coat, which is surrounded by a yellow area. Beneath the seed coat in the yellowed area are granules of starchy material. This injury may be caused from the time the bean pods are about half grown until the seed coat toughens just before maturity. The feeding of the insects on the blossoms causes them to drop."

The species causes loss of seed in alfalfa. It is a pest of cotton in California. When feeding on sugarbeets, it has been reported to prey also upon the sugarbeet leafhopper. Baker and Snyder (1946:500) have reported that "the toxic feeding of Lygus bugs is responsible in the California Lima bean crop for a seed spotting and pitting, and for some of the dropping of blossoms and pods." They also note that the insects have been reported to be "highly toxicogenic," to cause "severe blossom drop in alfalfa and cotton" and to "reduce germination of beet seed." They include a bibliography of ten titles.

Family **SALDIDAE** (Amyot and Serville, 1843)

Saldides Amyot and Serville, 1843.
Acanthiidae Stephens, 1829.

The Shore Bugs

The saldids are a cosmopolitan group of predaceous bugs almost all of which frequent the edges of ponds, streams, lakes, waterfalls, marshes and other moist places. An English species is said to be found on sand hills and dry heaths. However, the Hawaiian species form a partial exception to the rule in that there are some partially arboreal forms here—the only known arboreal saldids. They are active runners and fliers and frequently are difficult to capture; most of them are good jumpers. The saldids are considered by some workers to form a connecting link between the terrestrial and the aquatic groups of Heteroptera.

Ovate, subdepressed species; head wider across the eyes than front of pronotum; eyes large, strongly protuberant; two ocelli situated between the eyes; rostrum three-segmented, held free from the lower side of the head and prosternum in repose, the first and third segments unusually short, the second segment extraordinarily long; antennae four-segmented; brachypterous or macropterous in the same species; hemelytra without a cuneus, membrane, when developed, with several long, closed cells; tarsi three-segmented, the first segment short, claws long and slender, arolia absent.

Subfamily SALDINAE Van Duzee, 1917:438

Acanthiinae Reuter, 1912.

Genus **SALDULA** Van Duzee, 1914:387

Genotype: *Cimex saltatorius* Linnaeus, fixed by Van Duzee, 1914.
Acanthia Latreille, 1897, not Fabricius, 1775.

Saldula commonly are found along the edges of streams or on oozing banks in the mountains, but some species also frequent the damp forest floor at a distance from stream sides. The arboreal forms frequent damp moss-, lichen- and liverwort-covered trees and shrubs in the rain forests, but are not confined to such habitats, for they may occur also on the ground. Usinger has made some observations on the life histories of some of the species, but he has not published his results yet. He fed them on young longhorned grasshoppers. Williams (1944: 187) has seen one species "probing algal covered boulders for the larvae of Tipulidae."

When Kirkaldy wrote his first (1902) contribution for *Fauna Hawaiiensis,* he recognized two species and five "varieties." Later (1908) he described three new species and a new subspecies. Unfortunately, Kirkaldy apparently did not have *exulans* or *oahuensis* properly identified, and Usinger has shown me that two of Kirkaldy's forms must be reduced to synonymy. There are new species in our collections.

Brachypterous and macropterous forms occur. The hind wings may be reduced to small flaps.

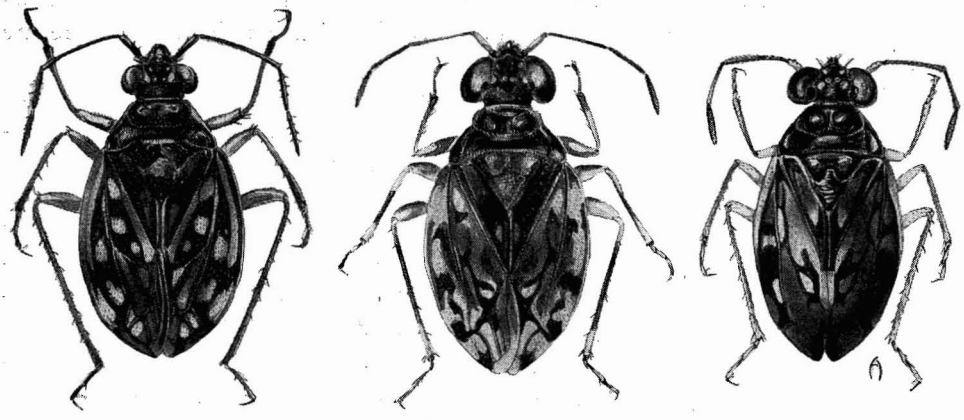

Figure 99—*Saldula exulans* (White), left. *Saldula oahuensis* (Blackburn), middle. *Saldula procellaris* (Kirkaldy), variety (?), right. (Abernathy drawings; not to same scale.)

KEY TO THE SPECIES OF HAWAIIAN SALDULA

1. Corial margins broadly explanate to well beyond middle; pubescence sparse, decumbent, body large (4.5 mm. or longer); head about two-thirds as broad as pronotum . . . . **exulans** (White).
   Head more than two-thirds as broad as pronotum; pubescence usually dense, usually appressed; body small (less than 4 mm.); costal margins less expanded (compare illustrations) . . . 2
2. Second and fourth antennal segments subequal in length . . . . . **nubigena** (Kirkaldy).
   Second antennal segment distinctly longer than fourth 3
3. Pubescence dense and appressed . . . . . **oahuensis** (Blackburn).
   Pubescence sparse and decumbent . . . . . **procellaris** (Kirkaldy).

Saldula exulans (White) (fig. 99).

Salda exulans White, 1878:373.

Acanthia exulans variety *molokaiensis* Kirkaldy, 1908:198 (type from Molokai Mountains). New synonym.

Saldula exulans (White) Van Duzee, 1936:229.

Endemic. Kauai(?), Oahu (type locality: "Sparingly in wet moss in one place on the mountains near the 'Pali' "), Molokai.

Saldula nubigena (Kirkaldy) (fig. 100).
Acanthia nubigena Kirkaldy, 1908:199.

Endemic. Maui (type locality: Mount Haleakala, 5,000 feet).
The type in the British Museum is figured here.

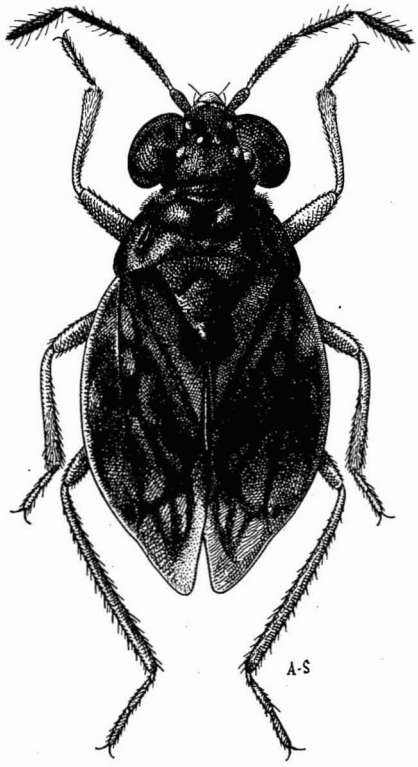

Figure 100—*Saldula nubigena* (Kirkaldy), holotype. (Drawn at the British Museum of Natural History by Smith.)

Saldula oahuensis (Blackburn) (fig. 99).
Salda Oahuensis Blackburn, 1888:353.
Saldula oahuensis (Blackburn) Van Duzee, 1936:229.
Acanthia humifera Kirkaldy, 1908:199 (type locality: northwest Koolau Mountains).
Saldula humifera (Kirkaldy) Van Duzee, 1936:229. New synonym.

Endemic. Kauai, Oahu (type locality: "Two specimens occurred near a waterfall several miles from Honolulu"), Molokai(?), Lanai, Maui, Hawaii.
This species has been found among wet leaves on the ground.

Kirkaldy did not know Blackburn's type (which is now in the Bishop Museum) and his *humifera* must fall as a synonym, according to Dr. Usinger's advice.

The hind wings on the holotype are reduced to flaps shorter than the breadth of the head.

Saldula procellaris (Kirkaldy) (fig. 99).
Acanthia procellaris Kirkaldy, 1908:200.
Saldula procellaris (Kirkaldy) Van Duzee, 1936:229.

Endemic. Oahu, Molokai (type locality: 4,000 feet), Lanai(?), Maui.

Family **HEBRIDAE** (Amyot and Serville, 1843)

Naeogeidae Kirkaldy, 1902:168.

The Velvet Water Bugs

This is one of the smallest families of the Heteroptera. It includes small aquatic or subaquatic bugs which have the body largely clothed with short, dense pile. Eyes strongly protuberant, a pair of ocelli present (very small and placed near the inner hind corners of the eyes in our species); antennae short, not extending behind the pronotum, four-segmented in our species; rostrum four-segmented,

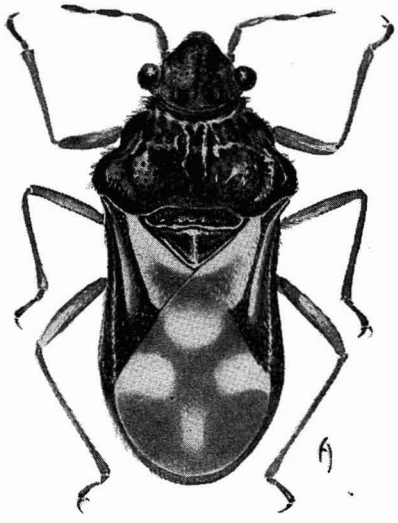

Figure 101—*Merragata hebroides* White. (Abernathy drawing.)

extending to between the metacoxae, base held within a groove on the underside of the head when in repose; hemelytra entire, without a cuneus, the membrane large, without veins; legs short and slender, coxae well-separated, tarsi two-segmented, with arolia, claws paired, long, terminal.

One immigrant species represents the family in our islands.

Genus **MERRAGATA** White, 1877:113

This is an American genus of few species.

Merragata hebroides White (fig. 101).

Merragata hebroides White, 1877:114. Genotype.

Oahu (type locality).

Immigrant. A widespread North American species.

This pretty little macropterous, predaceous bug walks about on the surface of ponds, streams and puddles, and readily submerges to explore submerged vegetation. It can stay underwater for a considerable length of time. Its life history should be worked out in detail.

Blackburn's field notes (as recorded by White, 1878:366) read as follows: "On small stagnant pools formed by the temporary overflow of streams on the higher mountains. When the pools dry up, the insect frequents the holes where the water has been."

Williams (1944:188, fig. 9) gives the following account:

> This is a compact little bug about 2 mm. long. It is rather leisurely, even tedious in its movements, and its short water-skimming flights do not suggest much energy. *Merragata* is a common insect at puddles, along stagnant portions of streams and in reservoirs, occurring there on algae and algal blankets. Both young and mature bugs readily pull themselves under water, where they become conspicuous because of their air-silvered bodies.... In the laboratory one was seen sucking the juices of an immature one of its own kind that still showed signs of life. And here it was preyed upon by *Mesovelia vagans* [error for *mulsanti* in text]....

Family **MESOVELIIDAE** Reuter, 1910

The Water Treaders

The mesoveliids constitute another small family of small, velvety, subaquatic bugs. Eyes large, protuberant, basal, the pair of ocelli subbasal and placed near the median line (obsolete in the apterous forms); antennae slender, four-segmented, reaching to behind the scutellum; rostrum not held against the head at repose,

three-segmented, segment two much longer than one plus three, exceeding the mesocoxae; hemelytra present or absent or brachypterous, corium long, with prominent veins, clavus membranous and membrane without veins in our species; legs long and slender, metacoxae contiguous, tarsi three-segmented, first segment very small, claws paired, slender, terminal, arolia absent.

The family contains only two genera.

Genus **MESOVELIA** Mulsant and Rey, 1852

Genotype: *Mesovelia furcata* Mulsant and Rey, the only species included by the authors.

These bugs run upon the surface of the water instead of swimming.

Mesovelia mulsanti White (figs. 102, 103).

Mesovelia Mulsanti White, 1879:268.

Hungerford, 1919:100–105, illustrated; gives a detailed account of this species, including its life history. Usinger, 1942:177, notes.

Kauai, Oahu, Molokai.

Immigrant. Widespread in North and South America. First found in the Territory by Williams at Waipio, Oahu, in 1933.

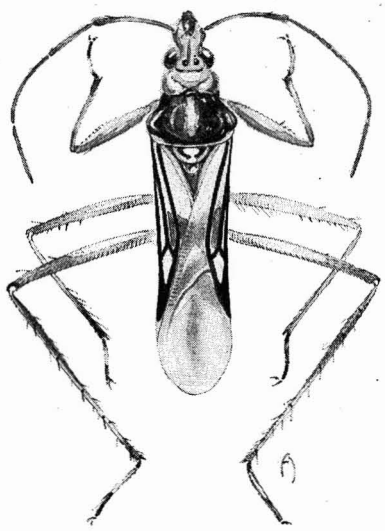

Figure 102—*Mesovelia mulsanti* White. (Abernathy drawing.)

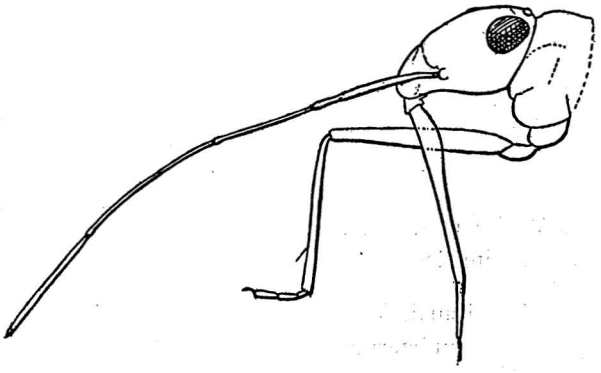

Figure 103—*Mesovelia mulsanti* White, profile of head to show the strong beak of this predaceous bug. (After Williams, 1944.)

This long-faced bug is now widespread, especially in lowland reservoirs, ponds, taro patches and such places, but it also ventures into the mountains in some areas. It frequents masses of algae and floating or partially submerged vegetation and moves over the water surface with great agility. The eggs are inserted in plant tissue. Both long- and short-winged forms occur. It is a fierce predator and feeds on many kinds of insects which venture near enough for it to grasp. Williams (1944:189–190, figs. 11–13) found that it fed on *Merragata hebroides* in captivity. It "often pounced upon a young *Merragata,* sometimes holding it down with aid of a foot or grasping it loosely with the legs and probing it for a deadly thrust. Or, *Mesovelia* would use only its beak for the attack. The thrust was sometimes made in a leg joint and sometimes in the body itself; in any case *Merragata* collapsed almost immediately, folding up its legs. It would then be held aloft to be sucked of its juices."

Family **VELIIDAE** Douglas and Scott, 1865

The Smaller Water Striders

A single immigrant species is our only representative of this small family of small, semi-aquatic bugs. Eyes comparatively large, protuberant, basal, ocelli obsolete; antennae four-segmented, not reaching apex of pronotum; rostrum received in a groove on the underside of the head, reaching only to behind fore coxae, four-segmented, third segment longer than the others combined (segment two small and sometimes difficult to see); pronotum and mesonotum fused, scutellum nearly or entirely hidden (in winged form); macropterous, brachypterous or hemelytra absent, when present entirely membranous and with conspicuous veins; legs comparatively short, all coxae separated, hind femora not extending beyond apex of abdomen in our species, fore tarsi two-segmented, mid and hind pairs three-segmented with the basal segment small in our species, claws preapical, paired, arolia wanting.

Genus **MICROVELIA** Westwood, 1834

Genotype: *Velia pygmaea* Dufour, fixed by Westwood, 1840.

A cosmopolitan genus containing a fairly large number of species.

Microvelia vagans White (fig. 104).
Microvelia vagans White, 1878:374.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.
Immigrant(?). Source undetermined. Described from the Territory, but no type locality given by White.

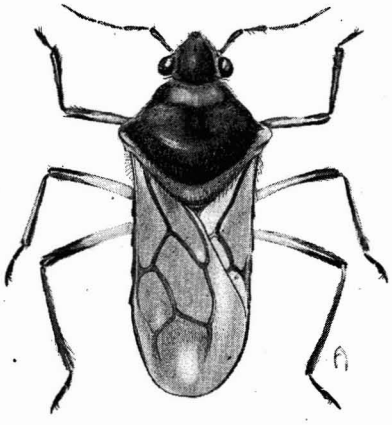

Figure 104—*Microvelia vagans* White. (Drawing by Abernathy.)

This is a common predaceous water bug from sea level to about 7,000 feet. It is found among such water plants as duckweed (*Lemna*) and inhabits ponds, puddles and running water. It is attracted to lights at night. Williams (1944: 192–193, fig. 10) gives the following noteworthy account:

It measures about 2.3 mm. long and is represented by both apterous and winged forms. It can be found on stagnant pools, taro ponds, lily ponds, the edges of sluggish streams where there is plenty of algal growth, and even in street gutters in wet districts. It will also find its way into tanks and other large water containers. It is not always on the surface of the water but patronizes the wet leaves and rocks nearby. A fiercely predaceous insect, *Microvelia* gangs up on chironomid flies as these emerge from their pupae at the surface of the water, and may overcome crane-flies issuing from some moss or algal growth. In the cool Mountainview region of the island of Hawaii, in October 1933, I witnessed successful attacks by *Microvelia* on the large, pale, dark spotted collembolan, probably *Salina,* that so often finds its way into pools with steep banks. *Salina* is an active leaper upon the surface of the water, nevertheless the bug succeeds in stabbing it in the back, or it would rush at it from the side. Once stabbed, *Salina* immediately collapsed. The presence in this pool of many dead and sucked-out *Salina* attested to the success of *Microvelia.*

Microvelia lays her eggs on dead leaves in pools, or elsewhere in the wet. The tiny red young may show silvery bubbles of air within the body, and a recently hatched individual clinging submerged to a leaf was observed with its proboscis at the surface, adding bubbles to its supply.

Family **GERRIDAE** (Leach, 1815) Dohrn, 1859

The Water Striders

All of the continents and most of the high islands of the world have fresh-water representatives of this group of water bugs. Hawaii has no fresh-water forms, but it does have two marine species.

Body densely clothed with velvety pile; eyes large, protuberant; ocelli postero-lateral, obsolescent in our species; antennae longer than head and pronotum, four-segmented; rostrum very short in our species, not surpassing fore coxae, obscurely four-segmented, the third segment longer than the others combined; pronotum shorter than head in our forms, scutellum and hemelytra wanting in our species; legs very long and slender, coxae well separated, tarsi two-segmented, claws pre-apical, paired, arolia absent.

Genus **HALOBATES** Eschscholtz, 1822:106

This is a remarkable and fascinating group of insects. Twenty-five species have been described, but other new species from the Pacific are known to us. They are not only morphologically peculiar, but they lead an entirely marine or even pelagic life. Little is known of their habits, but they are predaceous. I have thrown small objects into the sea where *Halobates* were swimming and have had them rush to and grasp the objects with great speed and facility. They probably prey upon a variety of small animals such as Crustacea. Those frequenting shoreside waters might also feed upon insects which are blown or fall into the sea. Usinger (1938: 77–84) found them to be "fiercely cannibalistic."

The head is broader across the eyes than the prothorax, which is reduced and is smaller than the head. The mesonotum is the largest part of the body, the abdomen is reduced, and the hind legs are peculiarly placed above the middle pair. None has wings.

Usinger (1938) gives a checklist of the species of the genus and a bibliography.

Key to the Hawaiian Halobates

1. Second antennal segment only slightly more than one-half as long as fourth; first segment of fore tarsus less than one-half length of second; ventrites without yellow coloring..... .....**sericeus** Eschscholtz.

2. Second antennal segment almost as long as or longer than fourth; first segment of fore tarsus only slightly shorter than second; ventrites, excluding genital capsule, mostly yellowish .....**hawaiiensis** Usinger.

Halobates hawaiiensis Usinger (fig. 105).

Halobates hawaiiensis Usinger, 1938:79, figs. 1–3.

Hawaiian pelagic water strider.

Endemic. Oahu (type locality: Waikiki, Honolulu).

This species is abundant along certain shores of Oahu.

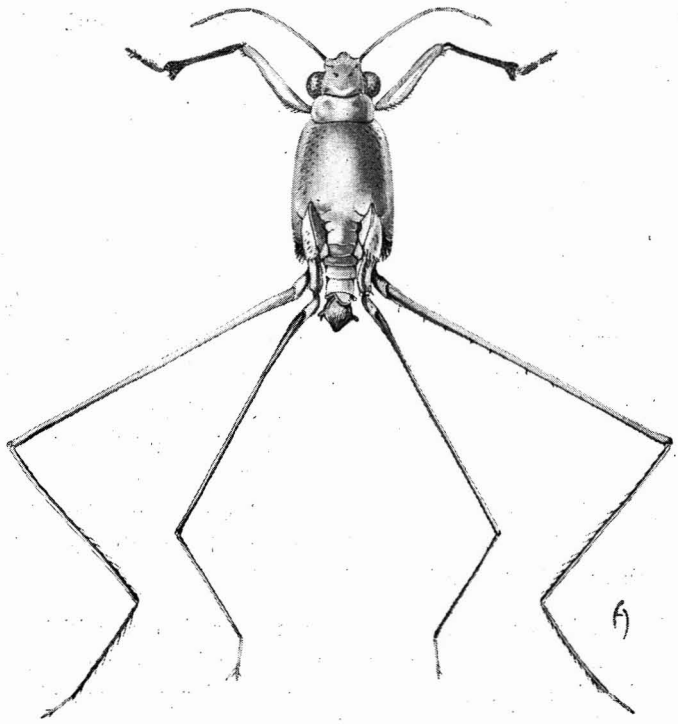

Figure 105—*Halobates hawaiiensis* Usinger, paratype, the Hawaiian pelagic water strider. (Abernathy drawing.)

Halobates sericeus Eschscholtz (fig. 106).

Halobates sericeus Eschscholtz, 1822:108, pl. 2, fig. 4.

Hadden, 1931:457–459, discussion.

Pelagic water strider.

Indigenous. Recorded from waters surrounding Oahu, Maui and Kahoolawe, but probably around all of the islands. Also found on Johnston Island. It is evidently a tropicopolitan species and has been found at sea far from land. It is driven ashore at times of storm.

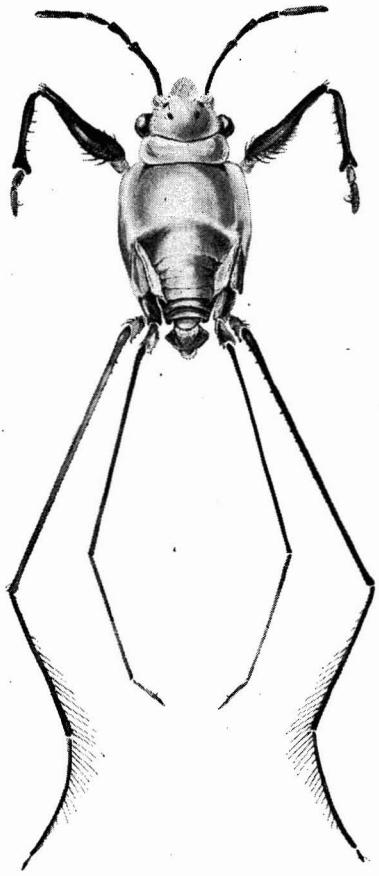

Figure 106—*Halobates sericeus* Eschscholtz, pelagic water strider. (Abernathy drawing.)

Series II—CRYPTOCERATA Fieber, 1851

This series, which elsewhere includes the aquatic families Gelastocoridae, Naucoridae, Nepidae, Belastomidae, Notonectidae and Corixidae, is not represented in the native Hawaiian fauna. We have here only a single immigrant representative of each of the two last-mentioned families.

The antennae, instead of being free and elongate, are short and hidden under the edges of the eyes.

Family **NOTONECTIDAE** (Leach, 1815) Samouelle, 1819

The Back-Swimmers

These peculiar bugs obtain their common name from the fact that they actually swim on their backs. Their dorsal surfaces are convex and shaped like the hull of a boat. They are truly aquatic, and they dive and swim well under water. Our species has the eyes very large, the inter-ocular space narrow; ocelli absent; antennae three-segmented, small and concealed from above beneath the edges of the eyes; rostrum short, stout, three-segmented, not surpassing fore coxae; scutellum broad, well-developed; hemelytra of similar texture throughout, without distinct veins; coxae contiguous or nearly so, mesocoxae lying in long sternal grooves in our species, hind legs longest, their tibiae and tarsi fringed; tarsi two-segmented, claws paired on fore and mid pair, absent on hind pair.

Genus **BUENOA** Kirkaldy, 1904

This is an American genus. The hemelytra are partially transparent.

Buenoa pallipes (Fabricius) (fig. 107, 108).

Notonecta pallipes Fabricius, 1803:103.

Buenoa pallipes (Fabricius) Kirkaldy, 1904:123.

Immigrant. An American species first collected in the Territory by Perkins about 1900.

This species is abundant in the lowlands, although it does extend its range to a few thousand feet elevation, and it flies actively. It is a voracious feeder on

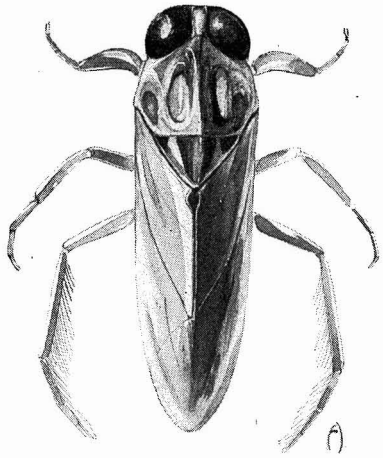

Figure 107—*Buenoa pallipes* (Fabricius), a back swimmer. (Abernathy drawing.)

almost all kinds of insects, including mosquito wrigglers, which it can capture and hold with its stout fore legs. It also feeds upon Crustacea. The males stridulate freely by rubbing a striated area on the innersides of the fore femora and tibia against the specialized base of the rostrum. Mating takes place under water. The eggs are inserted in the submerged tissues of plants. It can give a sharp, stinging "bite." "*Buenoa* while rising from time to time to the surface to renew its air supply, habitually keeps some inches below the surface, maintaining its position there by timely strokes of the posterior legs. Some of our lowland reservoirs teem with tiny crustacea, a *Daphnia*-like species for example being found in veritable clouds some distance beneath the surface. Ostracoda may also abound. Here *Buenoa* thrives.... Unlike *Arctocorixa* in Hawaii, *Buenoa* seems quite unable to endure salt water." (Williams, 1944:193–194, fig. 15.)

Family **CORIXIDAE** (Leach, 1815) Dohrn, 1859

The Water Boatmen

Elongate-oval, subdepressed, aquatic bugs; head overlapping prothorax, eyes large, subcontinuous in outline with the head, inter-ocular space wide, ocelli absent; antennae concealed from above beneath the edges of the eyes, four-segmented; rostrum short, broad, triangular, appearing as a continuation of the face, not distinctly beak-like as in most bugs; scutellum concealed by the pronotum; hemelytra complete, membrane not differentiated in texture from corium, veins wanting; fore coxae separated, mid and hind coxae contiguous or nearly so, front legs short, their tarsi composed of a single, large, expanded, fimbriated segment;

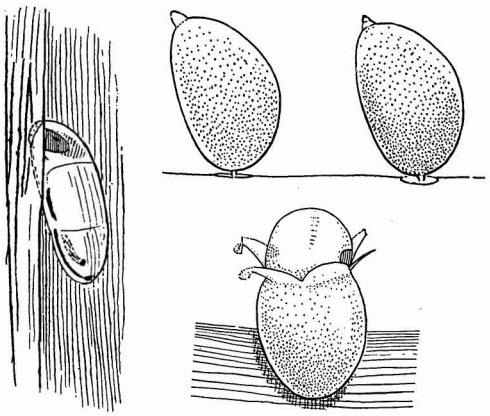

Figure 108—Eggs of two aquatic Heteroptera: left, *Buenoa pallipes* (Fabricius), egg embedded in plant tissue; right, eggs of *Trichocorixa reticulata* (Guérin-Méneville). Lower figure shows a nymph hatching from an egg. (After Williams, 1944.)

middle legs long and slender, tarsi single-segmented with two setaceous claws about as long as the tarsus; hind legs stouter, the two-segmented clawless tarsi compressed, expanded and fringed with long hairs; abdomen of males with the terminal three segments asymmetrical, twisted to the left or right.

The mouth parts of these bugs are peculiar and alone will separate them widely from all other Hemiptera. The rostrum is abbreviated and not elongated as is normal for bugs. This structure makes it possible for the bugs to swallow entire filaments of algae and to ingest certain small organisms whole.

Genus **TRICHOCORIXA** Kirkaldy, 1908

Trichocorixa reticulata (Guérin-Méneville) (figs. 108, 109).

Corisa reticulata Guérin-Méneville, in Sagra's Hist. de Cuba, 6:423, 1857.
Corixa Wallengreni Stål, 1859:268.
Corixa blackburni White, 1877:114.
Arctocorixa blackburni (White) of various authors.
See Sailer, 1946:617–620, for detailed synonymy, bibliography and notes.

Water boatman.

Oahu, Molokai, Maui.

Immigrant. A widespread American species (described from Cuba); established early in Hawaii.

This abundant insect looks, vaguely, more like some kind of a leafhopper than a bug. It frequently comes to light, sometimes in large numbers. It is common in brackish pools in the lowlands, but sometimes ventures up into the mountains. The small, whitish, top-shaped eggs are cemented to submerged objects. It is truly an

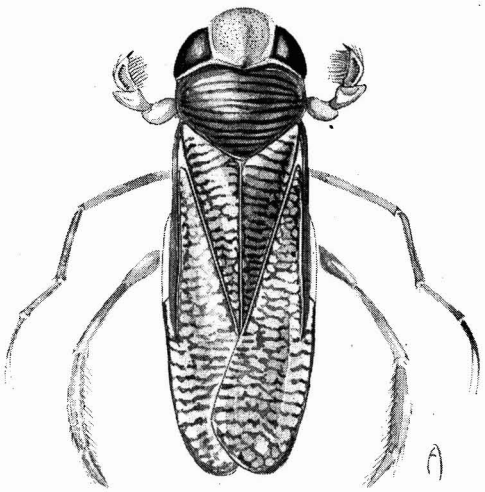

Figure 109—*Trichocorixa reticulata* (Guérin-Méneville), the water boatman. (Abernathy drawing.)

aquatic bug, and it can stay submerged for long periods of time. Its food consists of plant materials, such as filamentous algae and diatoms, and small animals which are found in the mud and ooze at the bottoms of ponds. Each pair of legs is adapted for a different purpose: the front ones are modified as scoops or shovels for food getting, the long slender middle ones are used to hold the insect in place while feeding, and the paddle-like hind legs are used for swimming.

The males stridulate by rubbing a series of small processes on the fore tarsi on a roughened area on the opposite femur. There is also an apparent stridulatory organ on the dorsum of the abdomen.

Blackburn's field notes (as recorded by White, 1878:366) are as follows: "Very common in salt-water pools on the sea-shore. These pools are formed artificially for the manufacture of salt. As the liquid becomes more dense by evaporation, the *Corixae* migrate to pools more recently filled. Some would appear, however, to remain too long, as, in the last stage of evaporation, the pools generally contain a few dead *Corixae* . . ."

From Williams (1944:195–196, fig. 16) the following notes are abstracted:

Our water boatman measures about 4.5 mm. long. The back of the thorax is finely banded with blackish while the elytra are finely but irregularly banded with brownish to black. The long posterior legs are hair fringed for propulsion by swift strokes. . . . It may fairly swarm in salty pools separated from the ocean by a low sandbar. . . . It is a bottom insect, coming to the surface only for air or to take flight. . . . Our corixid often takes flight in the daytime. It would seem that the shining surface of water attracts *Arctocorixa,* and we have seen them in the bright sunshine crashing against the polished hood of an automobile, evidently mistaking the shining metal for their proper element.

ADDENDUM

As noted on page 44, details of the identity and discovery of the following addition to our fauna were obtained while this volume was in press. Under the Alydinae, and following the section on *Ithamar* on page 47, add the following:

Coriscus pilosulus (Herrich-Schaeffer) (fig. 110).

Alydus pilosulus Herrich-Schaeffer, Abbildung Wanzenartiger Insecten 8:101, fig. 870, 1848. (I have not checked this reference.)

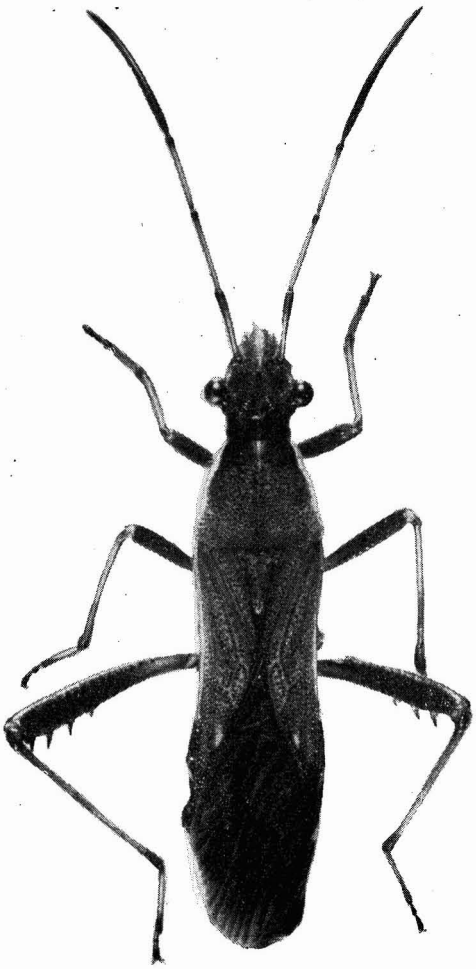

Figure 110—*Coriscus pilosulus* (Herrich-Schaeffer). (Length of body: 11 mm.)

Oahu.

Immigrant. First discovered in Hawaii by F. A. Bianchi, C. E. Pemberton and R. H. Van Zwaluwenburg at Poamoho, Oahu, May 25, 1948. Widespread in the United States from New England south to Florida and west to California.

The nymphs resemble ants, and it was this stage of the bug which first attracted the attention of Mr. Bianchi and resulted in the discovery of the insect in Hawaii. Bianchi fed specimens on *Leucaena glauca* and *Crotalaria* in the laboratory, but no feeding was observed in the field where the insect was found in a restricted area of weeds. Blatchley (1926:267) gives a redescription of the species and notes that it is common on *Saponaria* in Indiana and that it is "Frequent on weeds and grasses along the sandy margins of ponds."

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